

OCTOBER, 1949

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RAILWAY MECHANICAL ENGINEER

With which is incorporated the Railway Electrical Engineer. Founded in 1832 as the American Rail-Road Journal.

VOLUME 123

No. 10

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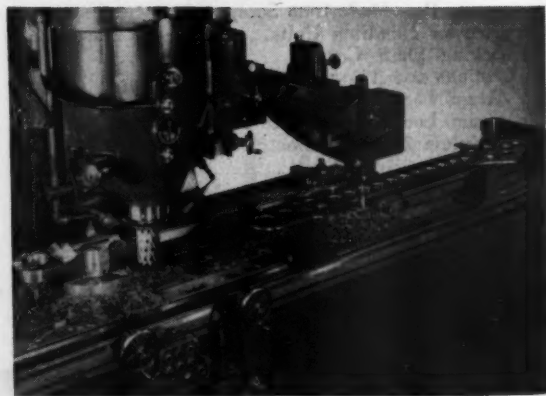
Round-Trip Cut

LOWERS COST OF MILLING SIDE RODS

Profile milling the end of locomotive side rod, the low cost automatic way—on a CINCINNATI Vertical Hydro-Tel.

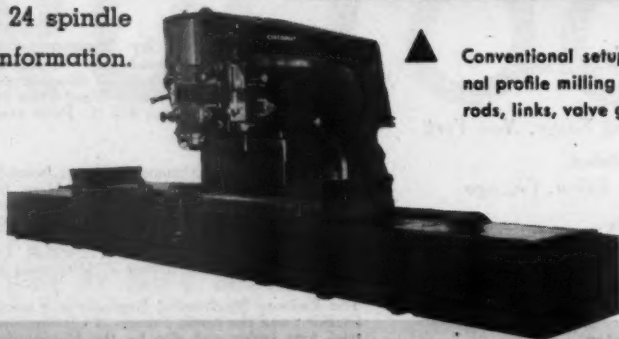


One way to take a short cut in arriving at lower costs is illustrated here. The entire profile of locomotive side rods is milled in one round-trip cut on a CINCINNATI 36" Vertical Hydro-Tel Milling Machine equipped for 360 degree automatic profiling. It's not necessary for the operator to pay close attention to the cutting action, nor to make a drawing on the part; the profiling unit takes over this work. It automatically follows the profile of templates... straight sections, angles, arcs, and curves that reverse; internal or external... all the way around the part. ¶ These Hydro-Tel Millers efficiently handle a variety of milling operations on heavy work; can be equipped for diesinking and/or automatic profiling. 50 hp spindle drive, 24 spindle speeds up to 1400 rpm. Write for more information.



Conventional setup for external and internal profile milling operations on connecting rods, links, valve gear rods, etc.

CINCINNATI 36" Vertical Hydro-Tel Milling Machine. Brief specifications may be found in the latest issue of Sweet's.

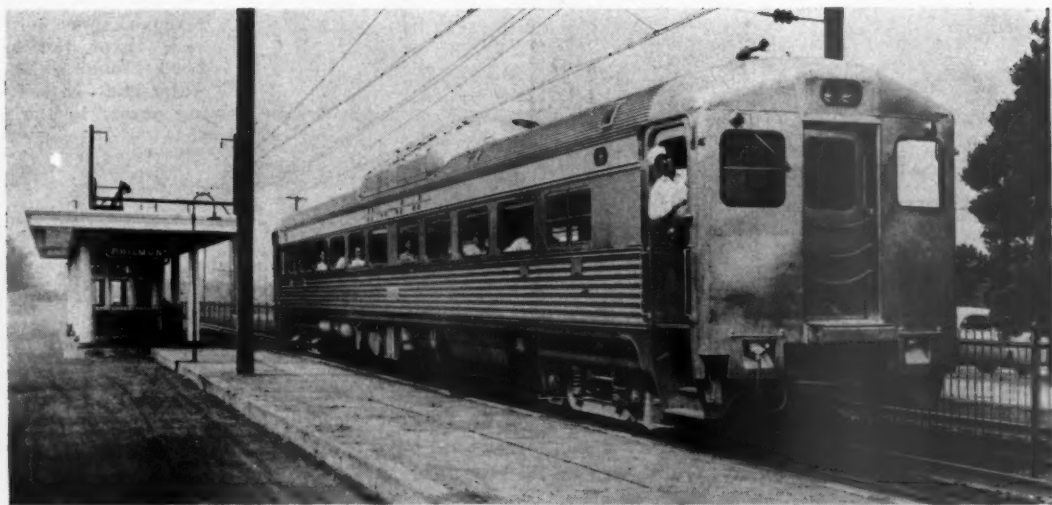


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RAILWAY MECHANICAL ENGINEER



BUDD RAIL DIESEL CAR

Stainless car with two power plants and torque converter transmission weighs 112,800 lb. — top speed is 83 m.p.h.

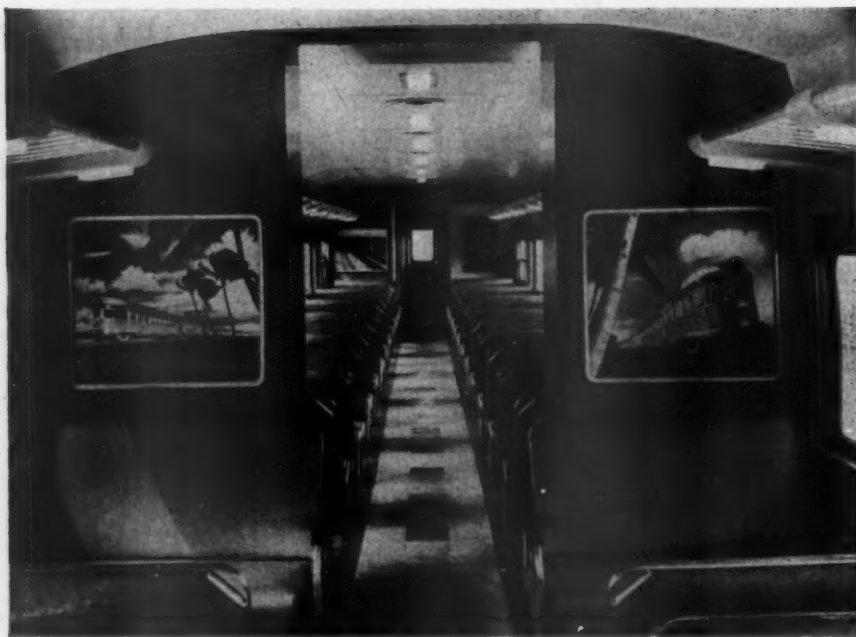
ON Monday, September 19, at Chicago, the Budd Company introduced its modern version of the rail car—a self-propelled stainless-steel unit powered by two 275-hp. Diesel engines with an hydraulic torque-converter transmission. The engines were built by the Detroit Diesel Engine Division of General Motors and the torque-converter transmission by the Allison Division of General Motors. The engine and transmission unit is designed for operation with the center line of the cylinders a few degrees above the horizontal so that they can be mounted underneath the car body. This is an outgrowth of a wartime development which was used for the propulsion of heavy tanks.

The car is 85 ft. long, coupled, and because there is no encroachment of the power plant on the space within the body, it has comfortably spaced seats for 90 passengers, with a toilet and electrical locker at each end. It weighs 112,800 lb. ready to run. It is designed for use singly or in trains under multiple-

unit control, by a single operator in a vestibule cab at either end, and is intended for full-scale service on branch lines, for supplementary main-line service, and for commuter service.

The rail-motor cars built following World War I were largely developed as a means of reducing losses in the then declining local passenger service. They were less than fully qualified for main-line service and power plants occupied space within the car bodies. The new car is intended to provide an attractive service as far as passenger comfort and speed are concerned on an economical basis by not encroaching on potential revenue space and by care in design to simplify maintenance. It is conceived to offer a means of restoring some part of the local business which competing agencies took away from the rails during the 1920's and since.

Three types of interior arrangement will be available. One, the type already built, is a passenger car with seats for 90 persons which the builder designates



The entire interior of the car is available as revenue space — This view shows the bulkhead through which the water and exhaust piping passes to the roof

RDC-1. Another will provide a 17-ft. baggage compartment and seats for 71. The third will have a 15-ft. railway-mail-service compartment in addition to the 17-ft. baggage compartment and will seat 49. These will be designated RDC-2 and RDC-7, respectively.

The car body is a stainless-steel structure, fabricated by the Budd Shotweld process. Unlike earlier Budd-built cars, the sides of this unit are girders, of which corrugated-side sheets form the webs and to which are attached the outside fluted stainless-steel surface. The car is designed to meet fully the strength specifications of the A.A.R. The center of gravity is 52.6 in. above the rail, an effect which is due in part to the location of the engines, transmissions and fuel tanks below the car floor.

The seats were especially designed. They are the walkover type, are comfortable in shape, and are low enough not to need footrests. This gives an unusually high space under the seat which adds to the leg room. Lighting is by fluorescent units in the center of the ceiling and lens type incandescent reading lights which are on the underside of the luggage racks over the seats.

The Power Plant

During the war there was a large demand for medium size Diesel engines for use in armored tanks, small boats and landing craft for various branches of the military services. Because Diesel engines of the sizes needed were not available, it was necessary to utilize multiple-engine power plants. These were so successful that they have been continued in many commercial applications since the war. After the war the Detroit Diesel Engine Division of General Motors undertook the development of a larger engine than that available during the war. This is the 275-hp. engine in use in the new Budd car.

There are a number of reasons for the selection of the 275-hp., two-cycle Diesel engine manufactured by

the Detroit Diesel Engine Division for this service. It would have been impossible to employ one engine of the necessary capacity which could have been placed under the car without encroaching upon revenue space. Each engine can be placed adjacent to the axle which it drives, simplifying the mechanical connection between engine and driven axle. Each engine, being smaller in size and lighter in weight than a single power plant, is less difficult to remove for maintenance. The two-engine installation gives greater reliability than would be the case if only a single-power plant were used.

These engines are two-cycle, with the cylinders inclined 20 deg. from the horizontal. There are six cylinders in line producing 275 hp. at a governor speed of 1,800 r.p.m. Each engine is supported at three points on rubber mounts and is enclosed in a demountable aluminum box, on the outside of which Neoprene has been applied as a sound deadener.

The torque-converter transmission was selected for its saving of several tons in weight, as well as for its effect on cost of the car. The Allison converter is essentially a combination converter and fluid coupling, with a lock-up clutch for direct drive so that the torque converter is used during acceleration periods only.

Reversing is accomplished by means of two sets of constant-mesh helical gears, one or the other of which is engaged to an extension of the engine shaft by an hydraulically actuated clutch to suit the direction of car movement desired.

The engine-cooling radiators are installed on the roof of the car and are connected by piping to insulated water tanks under the car. The exhaust-pipe and water connections from each engine are housed in ducts which form a partial bulkhead near the middle of the car. The water from the engine passes first through a storage tank under the car. This would normally be the water circuit during winter weather. When additional cooling is required, thermostats

open pipes which bypass the storage tank and lead through the radiators. When the water temperature

PARTIAL LIST OF MATERIALS AND EQUIPMENT ON THE BUDD DIESEL RAIL CAR

Steel castings	Pennsylvania Electric Steel Casting Co., Harrisburg, Pa.
End underframe, truck frame	Youngstown Steel Car Corp., Niles, Ohio
Truck forgings and I-beam equalisers	Canton Drop Forging & Manufacturing Co., Canton, Ohio
Truck springs	Union Spring & Manufacturing Co., New Kensington, Pa.
Shock absorbers—bolsters	Monroe Auto Equipment Co., Monroe, Mich.
Anti-wheel slide device; disc brakes	Budd Co., Philadelphia, Pa.
Coupler and yoke	National Malleable & Steel Castings Co., Cleveland, Ohio
Draft gear	Waugh Equipment Co., New York
Journal bearings	SKF Industries, Philadelphia, Pa.
Hand Brakes	National Brake Co., New York
Air brake system	New York Air Brake Co., New York
Air-brake compressors	Westinghouse Air Brake Company, Wilmerding, Pa.
Insulation and sound deadening	Gustin-Bacon Manufacturing Co., Kansas City, Mo.
Diesel engines	Detroit Diesel Engine Div., General Motors Corp., Detroit, Mich.
Torque converter	Allison Div., General Motors Corp., Indianapolis, Ind.
Axle drive unit; generator drive	Spicer Manufacturing Div., Dana Corp., Toledo, Ohio
Engine controllers; cooling and ventilating fans	Westinghouse Electric Corp., Pittsburgh, Pa.
Radiators	Harrison Radiator Div., General Motors Corp., Lockport, N. Y.
Muffler	Burgess-Manning Co., Libertyville, Ill.
Battery	Electric Storage Battery Co., Philadelphia, Pa.
Electric generator and controls; ceiling light fixtures	Safety Car Heating & Lighting Co., New York
Electric wire and cable	General Electric Co., Schenectady, N. Y.
Air conditioning	Frigidaire Div., General Motors Corp., Dayton, Ohio
Air distributors	Anemostat Corp. of America, New York
Air filters	Air Maze Corp., Cleveland, Ohio
Air grilles	Barber-Colman Co., Rockford, Ill.
Heating system and accessories	Vapor Heating Corp., Chicago
Drop sash, parcel racks	Adams & Westlake Co., Elkhart, Ind.
Window glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Panels and doors	Haskelite Manufacturing Corp., Grand Rapids, Mich.
Vestibule flooring	Alan Wood Steel Co., Conshohocken, Pa.
Floor covering—plastic tile	Johns-Manville, New York
Coach seats	Heywood-Wakefield Co., Gardner, Mass.
Hoppers	Duner Co., Chicago
Lavatories	Crane Co., Chicago

rises above 160 deg., the cooling-fan motors on the roof are automatically started by thermostatically controlled electric circuits. These fans cycle on and off under the control of the water temperature. Tests indicate that the heat-transfer capacity of the cooling system is adequate for the highest atmospheric temperatures.

Heat exchangers for the torque-converter fluid and lubricating oil form an integral part of the power plant. The pump which circulates the engine-cooling water delivers it from the storage tank or radiators, first to the torque-converter heat exchanger, then to the lubricating-oil heat exchanger, and then to the engine-water jacket.

Controls

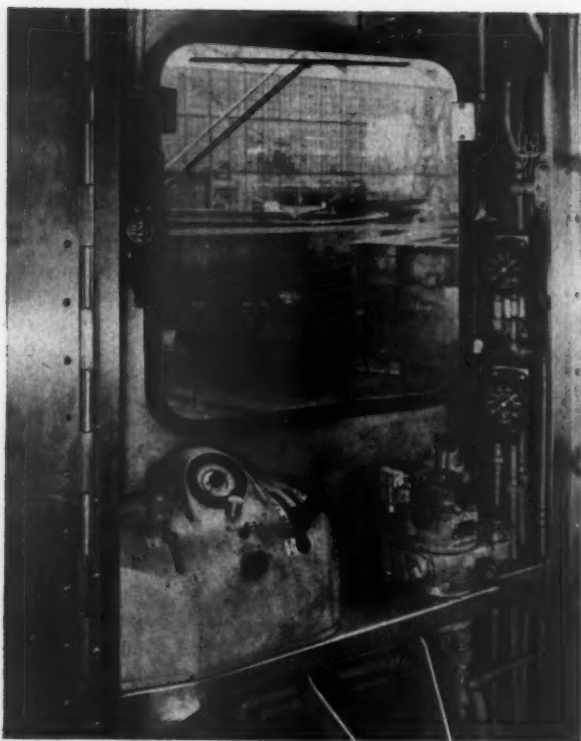
An operator's station is located at the right-hand side of the vestibule at each end of the car. There is a master controller, the engineman's brake valve, a bell-operating valve, whistle cord, an electric heater, a windshield wiper and defroster. The master control box has two handles. The one at the left has three positions—one for forward movement of the car, a middle neutral or off position, and a reverse-movement position. The right-hand handle has five positions. These are off, idle, second, third and fourth. The latter three operating positions represent one third, two thirds, and full crankshaft torque. The electric control circuits are interlocked so that the power-control lever cannot be removed from the off position until the direction handle has been set either in the forward or reverse position.

The torque-converter operates during acceleration up to a designated speed at which point the transmission automatically locks into direct drive. When decelerating, the direct drive clutch is automatically released and the torque-converter restored to operation.

A foot-operated deadman's control, lighting switches and folding seat complete the equipment at the operating stand. With the control and brake-valve handles removed from the master control box



The trucks have lightweight welded frames and Budd disc brakes



The operator's station in the vestibule

and the seat folded down, the controls can be enclosed by swinging the door which closes the end of the vestibule around 180 deg.

Each engine is started and stopped from the ground by push-button switches mounted on the side of the engine inside the housing.

Provision is made for automatic protection of the engine against overspeed, overheat, or loss of lubrication. The pilot switches for these functions are connected in parallel, the closing of any one of which closes the engine inlet damper, cutting off the air supply, stopping the engine and releasing the transmission clutch. In the case of engine or transmission difficulty while the car is running, manual declutching and idling is effected by a disconnect and shutdown switch in each electric locker for control of the engine at the end of the car only.

Electrical Equipment—Heating

Electric power equipment consists of two 64-volt 10-kw. generators, one of which is a part of each power plant. Batteries of 284 amp.-hr. capacity are carried in a stainless-steel box under the floor.

The car is air-conditioned by a seven-ton-capacity Frigidaire electro-mechanical system. Fresh air is taken in through screened openings at the side of the roof on each side at one end of the car. This passes through ducts to the plenum chamber. Recirculated air also enters the plenum chamber from the coach section. There are nine Anemostats through which the air enters the coach from the duct behind the ceiling over the aisle.

The passenger compartments are heated by hot water circulated through finned radiator pipes at the usual location at the floor along the sides of the car.

The water is drawn from the engine-cooling system and the car-heating radiators essentially take the place of the engine-cooling radiators during cold weather. Overhead heat is also supplied to the plenum chamber of the air circulating system from the same source. The water is circulated by thermostatically controlled pumps, that for the floor heat being connected with the engine-cooling system of one power plant and that for the overhead heat with the engine-cooling system of the other power plant.

To prevent freezing during standby periods in cold weather live steam from a yard line is fed to the cooling-water sump tank of each power plant through thermostatically operated valves. This maintains the temperature of the water in the tanks at 150 deg. F.

An overhead-mounted stainless-steel tank with a capacity of 75 gal. supplies water for wash bowls and toilets.

Trucks and Brakes

The four-wheel drop equalizer trucks are of special lightweight construction. The frames are built by up welding and have tubular side rails. The equalizers are forged I-beam sections, coil springs are used under the equalizers and swing bolsters and the bolsters are aligned by longitudinal rubber-insulated anchor rods. The trucks have a wheel base of 8 ft. 6 in., 33-in. wheels and SKF roller bearings for 5½-in. by 10-in. journals.

Each engine torque converter is connected to the inside axle of the adjacent truck through universals to a spline driving shaft and a Spicer drive assembly. The drive has a spiral bevel gear driving a ring gear incorporating a splined quill drive to the axle. A torque arm, which compensates for lateral motion of the axle, is resiliently connected to the truck transom.

The trucks are equipped with the Budd disc brake, Model CF, operated by New York HSC type air brakes with the D22 control valve. Two cast-iron discs are employed per axle, against the sides of which operate the asbestos-composition lining of the shoes. The shoes are applied against the discs by tongs, the long arms of which are forced apart by the pressure in the brake cylinder. During the test runs service stops were made without sand from 85 m.p.h. at a deceleration of 2.8 m.p.h. per sec. Emergency stops were made at 3½ m.p.h. per sec.

For brakes operating at these high rates of retardation an anti-wheel slide device is essential. The Budd Rolokron system is applied on both trucks. This consists of the Rolokron, which is mounted on a journal box of each axle, and a control box to which are connected the circuits from the Rolokrons. These are inertia devices which operate under the action of an excessive rate of deceleration of the wheels to close contacts which operate an electric solenoid valve in the control box to release air from the brake cylinder and, under control of a time relay, to reopen the circuit and reapply air to the brake cylinder after about one second.

Under the control of the Rolokron sand is automatically applied to the rail when emergency applications of the brakes are made. This is applied to the leading wheels of both trucks, depending upon

the direction of operation. When a single pair of wheels decelerates, sand is automatically applied in front of them. Sand boxes, each of 100 lb. capacity, have been installed in the sides of the car between the interior wall lining and exterior sheathing, one over each wheel. Access to these is through spring-loaded watertight covers in the sides of the car just below the belt rail.

Power-Plant Maintenance

One of the outstanding features of the power-plant installations is the simplicity of the attachment to the car body. Each power plant, consisting of the Diesel engine and transmission, a 10-kw. electric generator, and oil coolers is supported from the car body on rubber in compression at three points. Two of these are bolted connections at the transmission end of the plant and the other, tongue-supported in a suspension yoke.

It is not intended that more than minor adjustments and servicing are to be performed on the power plant while it is in place under the car. Whenever the engine and transmission need repair attentions, provision is made for removing the power plant from under the car and replacing it with another,

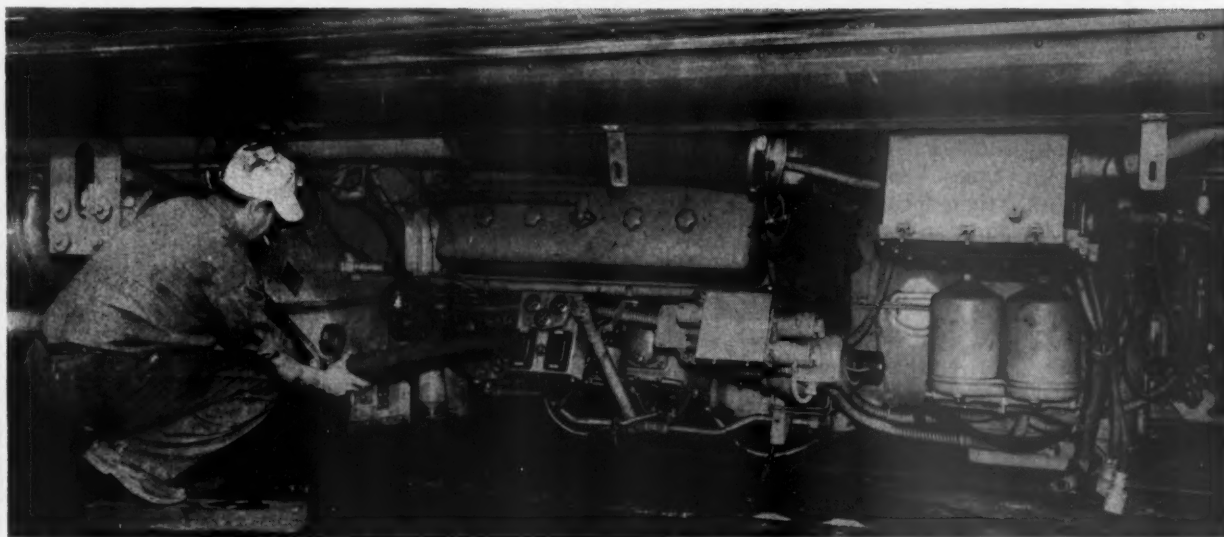
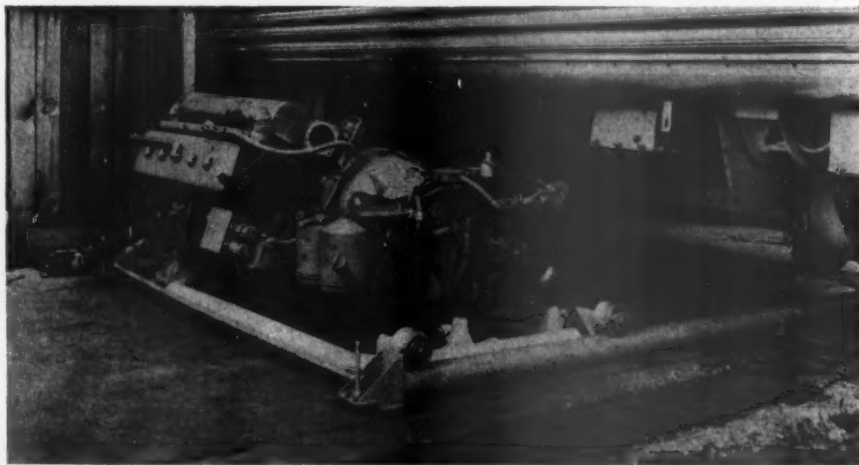
leaving the repair work to be done in a shop where all parts are accessible.

For the removal and replacement of the power plant a pair of rails of tubular section, spaced by tie rods at each end, are placed transversely under the power plant. Pads welded under these tubes support the frame on the track rails.

Running on the tubular rails is a dolly which supports three jacks, two at one end and one at the other. After the spline shaft, water and electric connections to the power plant have been separated, the dolly is rolled under the power plant until the jacks are in place under the pads on its under side. The jacks are then raised to support the power plant, the supporting bolts are removed from the transmission end, and the yoke in which rests the tongue at the other end of the plant swung out of the way. The jacks are then lowered and the entire power plant rolled out from under the car where it can be picked up by crane for movement to the shop. Another plant can then be installed by the reverse process.

An engine has been removed from under the car by four men in 20 min. Based on experience to date, it is anticipated that a power plant can be disconnected, removed and replaced in an hour and a half.

Each power plant is removable as a unit—At the right the unit is on a special dolly ready to be rolled under the car—Below, the water connections have just been broken preparatory to removal



New L. & N. Power Reduces Operating Costs



The Diesel pusher will be uncoupled at the top of the hill without stopping the train—it runs "backward" up the hill so that it will have better visibility returning light down the hill

Acquisition of 2-8-4 units make it possible to retire 91 obsolete steam locomotives and increase ratings

SINCE the end of the war, the Louisville & Nashville has acquired new road freight steam power and Diesel pusher units that have made it possible to effect operating economies. The steam power consists of 22 heavy 2-8-4 freight locomotives, built by the Lima-Hamilton Corporation early this year. These 22 new units have made it possible to retire 91 old steam locomotives. They have shown a fuel saving of 12 per cent over the next best steam freight locomotives on the L. & N., and, in conjunction with a four-unit Electro Motive Diesel pusher, have increased the tonnage rating of coal trains over several principal divisions from 6,650 tons to 9,500 tons while helping to increase the system average gross ton miles per train hour by 18 per cent. This new steam and Diesel motive power, along with an increase of C.T.C. installation, cost some \$7.6 million

and is expected to result in operating savings of about one million dollars per year. Another \$475,000 is expected to be saved when 30 new Diesel switchers are put in service.

These 2-8-4 locomotives are designated the M-1 Class, and bring the total number of this class to 42. The first 20 locomotives of this class were built by the Baldwin Locomotive Works. Of 14 completed in the fall of 1942, 10 have been used continuously to date in heavy freight service, and four throughout a period of approximately 5½ years ended May 1948, in both heavy freight and passenger service. The next lot of six were delivered in the third quarter of 1944, and have been used continuously in heavy freight service.

These M-1 locomotives have been one of the principal factors in increasing the road's train miles per

train hour from 14.9 in 1942 to 16.5 in May, 1949, the increase in speed occurring at the same time that tonnages per train were increased. The 2-8-4's are used principally between Corbin, Ky., and DeCoursey, a run of 185 mi., and between Neon, Ky., and DeCoursey, 276 mi. On this latter run the locomotives are serviced at Ravenna, about half way en route, while the train is being switched and inspected. The M-1's are also used between Loyall, Ky., and Corbin, 67 mi., when they are not needed on the first two runs.

The enginehouses required or used for these locomotives are at the turning points, Corbin, DeCoursey and Neon, and at Ravenna where the locomotive is serviced during the layover of the train.

The M-1's have a tractive force including booster of 79,390 lb. and are capable of handling a gross train weight of 9,950 tons at about 40 mi. per hr. On test with a dynamometer car they developed 4,503 maximum drawbar horsepower at 42 m.p.h. They have 69-in. drivers, are roller bearing equipped throughout except on crankpins, and have one-piece bed frames with integral cylinders. The tenders carry 25 tons of coal and 22,000 gal. of water.

Availability High—Maintenance Low

The M-1 class locomotives have high availability, with an average turning time for mechanical servicing requirements at the end of each trip of less than 1½ hours. Monthly inspection and boiler washes, and quarterly semi-annual inspections, are given in 24 hours. An annual inspection and repairs takes 7 days. They go 300,000 miles between Class 3 repairs. No Class 5 repairs are needed or extended to these locomotives. The 20-year-old 2-8-2's replaced by M-1's required 14 days for a Class 5 repair which includes the annual, made only 180,000 mi. between Class 3 repairs, and required three Class 5 repairs between Class 3's.

In February 1943, accurate records of operating costs were started on four of the Baldwin locomotives.

TABLE I—COST OF OPERATING FOUR 2-8-4 STEAM LOCOMOTIVES OVER A 6 1/3 YEAR PERIOD*

LOCOMOTIVES 1960, 1961, 1962, 1963	
Period	Cost per Mile per Locomotive
1943 (11 Months, February–December).....	\$0.38
1944.....	0.44
1945.....	0.60
1946.....	0.60
1947.....	0.68
1948.....	0.97
1949 (5 Months, January–May).....	1.10

* Includes fuel, water, lubricants, supplies, enginehouse expense, and all repairs (Classified and otherwise).

TABLE II—MAINTENANCE DATA FOR FOUR 2-8-4 LOCOMOTIVES BUILT IN 1942, FROM AGE OF SIX MONTHS TO JUNE 1, 1949

Total repair cost.....	\$ 220,729*
Total miles run.....	\$1,821,068
Cost per mile.....	\$ 0.1212

* Includes cost of one Class 3 repairs to each locomotive, given at approximately 300,000 miles.

TABLE III—COST DATA FOR DIESEL PUSHERS

AUGUST, 1948 TO MAY, 1949 INCLUSIVE

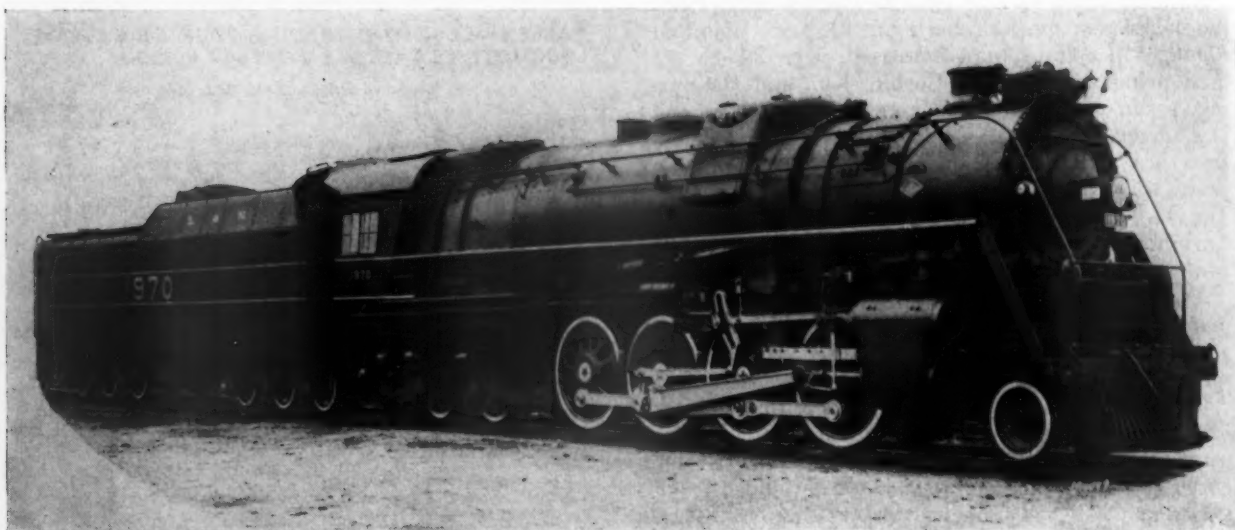
Maintenance, fuel and lubrication cost.....	\$51,923.87
Total miles operated.....	103,100
Average cost per mile (per unit).....	\$ 0.50
Maintenance cost only.....	\$14,697.65
Maintenance cost per mile (per unit).....	\$ 0.14

TABLE IV—COAL CONSUMPTION IN LB. PER 1,000 G.T.M.

	1948	1949
January.....	151	130
February.....	142	129
March.....	146	130
April.....	128	118
May.....	124	109
June.....	125	...
July.....	120	...
August.....	123	...
September.....	121	...
October.....	126	...
November.....	128	...
December.....	132	...
Average (First 5 months).....	138.2	123.2
Savings from sized-washed coal, per cent.....	...	10.85

Principal runs to which the 42 M-1 Class 2-8-4 locomotives are assigned





One of the group of 22 M-1's built by Lima-Hamilton which developed 4,503 drawbar horsepower at 42 m.p.h.

Table I shows the average operating costs per mile from the time they were about six months old to the present. The costs listed in this table include all repairs, both running and classified, all enginehouse expense, fuel, water, lubricants and supplies. Table II gives the total accumulative maintenance cost of the same four locomotives over the same period. The average maintenance cost per mile was 12.12 cents during the 6 $\frac{1}{3}$ year period. The four locomotives underwent one Class 3 repair during this interval at an average cost of a little over \$7,000 each, which is included in the total repair cost.

Savings from Sized Coal

Over and above the 12 per cent saving in fuel effected by the M-1's over the 2-8-2's when equivalent grades of fuel were burned, an additional saving of over 10 per cent in the coal bill has been made by using sized coal. This has resulted in a saving of over \$1,000,000 a year on the railroad's fuel bill alone. The use of this sized and washed coal with all fines removed has also eliminated the stopping up of flues and the slagging of the flue sheets, and has reduced clinkering of the fire. By actual test the better coal was also shown to be capable of increasing the boiler evaporation by about 15 per cent.

All coal used by the L. & N. now has a minimum size limit of $\frac{3}{8}$ in. Most of it has a maximum size limit of 3 in. to prevent undue flaking and crushing. Coal from some areas is allowed to go as large as 4 in., and in some cases even to 6 in., depending on the combination of various qualities and the availability.

The effect of changing over from 100 per cent consumption of run-of-mine coal in the beginning of 1948 to the 100 per cent use of washed and sized coal in 1949 is shown in Table IV. The average for the first five months of 1948 was 138.2 lb. coal per 1,000 gross ton miles. In 1949 the corresponding five months' average was 123.2 lb., or a reduction of 10.85 per cent.

Diesel Pusher Operation

To permit a single 2-8-4 locomotive to handle 9,500-ton trains over the entire run from Neon to DeCoursey, 276 miles, Diesel pusher service is employed over Elkatawa Hill, which is about two-thirds of the way from Neon to Ravenna. Northbound this hill has a three-mile upgrade of 1.2 per cent; Southbound it has four miles of 1 per cent grade. A Diesel pusher locomotive consisting of four 1,500-hp. units, constantly available at the hill, is required to push all northbound loaded car trains and some southbound empty car trains over the grades.

Five 1,500-hp. E.M.D. F-3 units (two A units and three B units) are assigned to this service as it is necessary to exchange, each week, one unit and send it to Ravenna engine terminal for monthly inspection and maintenance, there being no maintenance facilities at Elkatawa Hill.

While the primary purpose of the Diesel pushers is to help the 2-8-4's up the 1.2 per cent grade with a train of loaded cars, they are also used on some southbound trains of empty cars. Normally a 2-8-4 on a southbound train handles 115 empties unassisted up the 1 per cent grade. As the 115-car trains of empties are not quite sufficient to balance the trains of loaded cars going in the opposite direction where an equal number of trains are to be run each way, some of the southbound trains of empties carry 140 cars. When 140 cars are run in one train, the Diesel pusher assists the road locomotive up the 1 per cent southbound grade.

Before the 2-8-4's were assigned to the run over Elkatawa Hill, three Diesel units were used to help the 2-8-2 and its 6,650-ton train up the northbound grade.

Pushers Uncoupled Without Stopping

Two operating practices were developed by the L. & N. to improve the Diesel-pusher operation. With the first one an emergency application of air by either

locomotive automatically cuts off the power of the Diesel pusher. The second development is that the pushers are uncoupled at the top of the hill without having to stop the train.

The equipment used for uncoupling while in motion consists of two long rods which fit in a special rack of the caboose of the train being pushed. The first rod shuts off the angle cock on the caboose immediately prior to uncoupling. The second rod has a chain on the top leading to the caboose platform and contacts a piece of iron clamped on the train line. Pulling up on the chain breaks the train line connection without damage. The conductor can also close the locomotive angle cock by the same rod that is used to shut the caboose cock.

When starting a train up the Elkatawa grade, curvature prevents the engineman on the Diesel pusher from seeing the steam locomotive on the head end. To overcome this difficulty several switches and ordinary light bulbs were installed along the right-of-way. When the steam locomotive engineman is ready to start, the throttle is opened wide and at the same time the nearest switch is thrown lighting up a bulb near the Diesel. The steam locomotive throttle is left wide open until the Diesel is ready to start.

Other Helper Service

Helper service employed at other points is best illustrated by following an average run of a typical train from Neon to DeCoursey and from Corbin to DeCoursey. An M-1 leaving Neon with 9,500 tons runs the 153 miles to Ravenna unassisted except for the

Diesel pusher help over Elkatawa Hill. Two M-1's are used for the 27-mi. run from Ravenna to Winchester. The limiting grade is 0.4 per cent compensated, with one continuous section of 0.4 per cent grade 15 miles long. The M-1 pusher is cut off at Winchester without stopping the train in the same manner that the Diesel pusher is cut off at the top of Elkatawa Hill. The 93 miles from Winchester to DeCoursey is operated with a single 2-8-4 handling the 9,500-ton train.

On the second major run to which the M-1's are assigned, two leave Corbin with 8,300 tons. At Ford, Ky., 80 miles from Corbin, a third M-1 is added to the train to push it up the heavy grade to Winchester. From Winchester to DeCoursey a single M-1 handles the 8,300-ton train. Normally the 8,300-ton train is continued through to DeCoursey without filling out to the 9,500 tons which the M-1 handles on trains from the other division into Winchester. Actually, on test, the locomotives have shown sufficient capacity to handle well over 9,500 tons. On one particular test, 11,056 tons were moved from Winchester to DeCoursey in 3 hours 16 minutes, making two stops. The locomotive was worked at capacity only when starting.

If M-1's are available beyond requirements on the two runs just described, they are used between Corbin and Loyall, a run of 67 miles. On this division one M-1 handles 8,300 tons out of Loyall as far as Emanuel, Ky., a run of 57 miles. Up a three-mile hill westward out of Emanuel, a 2-8-2 pusher is used. The M-1 handles the train the remaining distance to Corbin unassisted.



The maintenance cost, including classified repairs, for the four of these Baldwin-built locomotives averaged 12.12 cents per mile during a 6-1/3-year period

Modernizing the Steam Locomotive

Higher pressures call for water-tube boilers and uniflow cylinders on steam turbines—A fresh approach to the selection of auxiliaries

TRANSPORTATION is vital both in peace and war, yet we are converting more and more railroad motive power to liquid fuel. By doing this we are putting more and more eggs in one basket. In a national emergency we need all the liquid fuel we can get for army, navy, and air force. Aircraft, in particular, require the highest grades of fuel and no reasonable substitutes are yet available. However, our railroad transportation system is more flexible from a fuel standpoint since steam locomotives can readily use coal, a mineral fuel, which, according to the best authorities, is available at the present rate of consumption for hundreds of years to come.

Why, then, is it not worth time and effort to keep our railroads coal burning to relieve?

One answer is to convert coal to liquid fuel by processes such as the hydrogenation of coal. This is entirely feasible and, at the present time, several test plants are in operation and under consideration, but their initial cost is very high and, in emergencies, their whole output would have to be reserved for the military. Also, such plants would have to be large to make them economically feasible; hence, they would be few in number and not too well dispersed. Therefore, it would not be too difficult to put them out of operation.

The preferable alternative is to use the coal in its natural state. If it is agreed that this would be preferable, the problem is to make the steam locomotive attractive to the railroads.

Recently the New York Central conducted the first full-scale comparative tests between the steam locomotive and the Diesel. They used half modern steam locomotives and half Diesels over the same routes, giving both types adequate maintenance and service facilities. The results were interesting because there was not the wide difference in operating costs that some people would have you believe existed. The final cost of operation figures quoted by P. W. Kiefer, chief engineer equipment, New York Central System, show that a 6,000-hp. reciprocating steam locomotive costs less to operate per mile per year than a 6,000-hp. Diesel.

At this point many arguments could readily get

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*By Chadwell O'Connor**

off to a good start both for pro's and con's, but the one point that can honestly be made is the favorable position steam locomotion is in as compared to Diesel because it can be improved as much as 100 per cent, whereas Diesel is just about at its peak.

From Mr. Kiefer's figures, it is evident that the steam locomotive could compete favorably with little increase in overall efficiency. Can this be done without costly experimenting?

Increasing Steam Efficiency

Until the advent of the Diesel neither railroads nor locomotive manufacturers had sufficient incentive to break away from conventional designs with a view toward increasing efficiency, but, today, with the stiff competition of Diesel engines and the high cost of fuels, the need for a new approach to the problem is imperative.

In the field of electric power generation, steam is still undisputedly the most economical prime mover in sizes over about 8,000 kw. and on board ships of about 5,000 hp. and larger. These power plants consume only about 6 to 8 lb. of steam per horsepower hour, yet the average locomotive requires 20 lb. or better of steam per horsepower hour. The best is about 15 lb., three times as much as other power plants.

Why is there such a discrepancy?

The first and most obvious answer is condensing vs. noncondensing. This accounts for a fair share of the difference in efficiencies, but by no means is the ratio 3 to 1. In fact it accounts for only about 25 to 50 per cent of the difference. From this it is apparent that efficiencies could be increased 100 per cent over present-day practice, thus cutting fuel consumption in half, reducing necessary boiler capacity by one half and, last but not least, reducing water consumption by one half. How can this be done?

The present-day locomotive is a highly efficient engine considering the limitations presently imposed on it. Therefore, it is necessary to lift or circumvent these limitations.

To increase the efficiency of the steam locomotive

to emulate steam power-plant practice, it is necessary to increase the temperature and pressure of the steam to the engine, decrease exhaust pressures, utilize the steam to better advantage, increase feedwater temperatures without decreasing heat available for work, and decrease steam used in auxiliaries which is very high and a dead loss on present locomotives.

Steam Pressure

Steam pressures cannot be increased by any appreciable amount over current practice with the fire-tube boiler. The water-tube type boiler, however, is giving excellent service in power plants and on board ship at pressures from 600 lb. per sq. in. to well over 1,250 lb. per sq. in.

A fire-tube type locomotive boiler has been proposed for high pressures, using a water-tube firebox and throat, thus eliminating staybolt surfaces. Although it is a step in the right direction, it represents unnecessary compromises with good water-tube practice, such as allowing the main drums to be exposed directly to the fire, and the use of bifurcated tubes, etc. The more satisfactory answer is a full-fledged water-tube boiler designed along the latest approved practices.

Water-Tube Boilers

There are four types of water-tube boilers: the flash boiler, the semi-flash boiler, the natural circulation boiler, and the forced-circulation boiler.

The flash and semi-flash boilers are ideal in many respects, especially from a theoretical standpoint. However, they still present many problems not found in the conventional water-tube boiler. These have not been entirely solved.

Natural circulation water-tube boilers have not been used on locomotives except experimentally. By the nature of their design they are rectangular and, hence, difficult to conform to standard locomotive limitations. Therefore, two things have to be done. First, more vertical space has to be made on the locomotive without impairing wheel arrangement, and, second, the height of a water-tube boiler decreased.

One possible solution to available height is taking a wheel arrangement similar to the Pennsylvania four-cylinder rigid-frame 4-4-4-4, or the Baltimore & Ohio 4-4-4-4 rigid-frame engines and separating the frame in the middle and tying the two sets of drivers together by a third frame with a drop center which would support a water-tube boiler. This arrangement would have further advantages, such as better distribution of weight on the drivers, better flexibility on curves, and, in the case of the reciprocating engine, less reciprocating weight and more room for ash pans.

This double articulated arrangement is used in the English colonies, except that they use a conventional boiler and do not utilize the space between the drivers, the boiler itself acting as the tie frame. An example is the general purpose Beyer-Garratt 4-6-4 + 4-6-4 used on the Gwelo-Salisbury section of the Rhodesia main line. The new Chesapeake & Ohio turbo-electric locomotive also uses a somewhat similar articulated frame arrangement.

When the height of a water-tube boiler is reduced,

the convection or natural circulation is reduced for a given size unit, but, if suitable means of inducing or forcing circulation can be employed, not only can the difference be made up, but heat transfer rates can be increased several times.

During the war an experimental high-pressure boiler of this type was developed which consistently produced 1 b.hp. from each square foot of heating surface with a thermal efficiency of 80 per cent.* The unit has all of the advantages of the conventional water-tube boiler plus high heat transfer rates. The firebox is between the upper and lower drums, further reducing the height of the unit and completely enclosing the firebox with water tubes and water walls.

In short, a forced-circulation steam generator of this type would fit the space limitations and allow pressures and temperatures to go as high as metallurgy will allow which at present is about 1,000 deg. and almost any pressure. However, in the interests of initial cost, standardization of equipment and low maintenance, 600 to 900 lb. per sq. in. pressure and 700 deg. F. for reciprocating engines and 950 deg. for turbines would be the most practical.

Burner and Furnace

It is in the burner and furnace that steam power has its greatest advantage—the ability to burn cheap fuels. But, it is here also that steam has some of its disadvantages—poor combustion efficiency because of poor coal, improper handling, complicated equipment affected by cold weather, and uncontrolled draft, all of which affect adversely clean, economical operation. Ash disposal also presents its problems.

There is only one method of firing which eliminates, or at least simplifies, the aforementioned problems and that is pulverized coal firing. True, pulverized coal adds a few problems of its own, but they have been solved for stationary water-tube boilers. More nearly approximating the locomotive application is the marine field. It was found that with the Clarke-Chapman system low-grade slack coals could be used. After extensive trial runs the system was pronounced a commercial success. The biggest single problem was slagging, but with water walls and proper furnace design the slag fell to the bottom where it was cooled by tubes on the bottom of the furnace floor and drawn off through a special door.

Scotch marine boilers with their small fireboxes have successfully burned pulverized coal with fusion temperatures of the ash as low as 2,264 deg. F. So, with a flexible water-tube boiler design such as is available with forced circulation, a pulverized coal-burning locomotive which would be capable of burning low grades of coal with the simplicity and availability of oil burners is well within our grasp.

In view of the sometimes erratic supply of coal, the pulverized coal burners mentioned above can be built with an oil burner atomizer in the center which may be used as an alternate.

Exhaust Pressure

Better than 10 per cent thermal efficiency is lost by exhausting against 26 lb. per sq. in. as the stand-

* Developed and patented by the author.

ard locomotive does to obtain a draft, as against exhausting at atmospheric pressure. With atmospheric exhaust the effective pressure is increased about 9 per cent, thus producing more horsepower for a given size engine.

To replace the exhaust nozzle an induced draft fan similar to those used on board ship and in stationary power plants should be used. Such a fan can be controlled at will to suit combustion rates. The control should be made automatic to control the excess air to about 20 per cent. This would increase combustion efficiency substantially above present practice, reduce smoke to a negligible quantity, eliminate human element, and increase availability and utilization.

Utilizing Steam

A single-expansion reciprocating engine is out of the question for real efficiency as now used. It was abandoned over fifty years ago in favor of compound triple and quadruple expansion for all other services. However, all attempts to use them on rails have been futile for several reasons—high back pressure, low initial pressures, weight, cost of parts, and inflexibility. There is, however, one type of engine which, today, can compete with the turbine and Diesel—namely, the uniflow engine.

A uniflow engine gets full expansion in one cylinder and is more efficient than a quadruple expansion engine. All control is through the valves so that the engine has an almost flat efficiency curve from $\frac{1}{4}$ to $\frac{5}{4}$ load. Poppet valves, currently used, will lend themselves to higher temperatures and pressures.

For locomotives nothing could be better—high starting torque, with up to 90 per cent cut-off, which would be cut as soon as underway to 10 per cent or less, depending on the load. With this arrangement starting torques would be comparable to that of a Diesel, thermal efficiencies would be twice current reciprocating practice, wire-drawing would be materially reduced, and valve driving gear would be simplified and lightened.

The uniflow engine can utilize high pressures and greatly reduce cylinder condensation. Both Stumpf and Lentz have built uniflow engines that consumed only 5.6 lb. of steam per horsepower operating on about 450 lb. and 800 deg. to 900 deg. Correcting for noncondensing service, this would give about 8 to 10 lb. of steam per horsepower-hour or about one half the steam consumption of present-day steam locomotives.

There are two major drawbacks to the reciprocating engine. The steam temperature can not exceed about 800 deg. because lubricating oil breaks down beyond this temperature, and the multiplicity of moving parts. Steam turbines can operate continuously year in and year out at pressures above 1,000 lb. and up to 1,000 deg. F. with a corresponding increase in efficiency. They are essentially a vibrationless one-moving-part machine. By extracting steam from various stages of a turbine and heating feedwater with it, the steam has done work and at the same time returns B.t.u. for B.t.u. back to the boiler in the form of hotter feedwater which materially increases thermal efficiency.

John S. Newton, assistant manager of engineering, Steam Division, Westinghouse Electric Corporation, in an article on coal-burning steam-turbine locomotives,* shows steam consumptions of turbines at various horsepowers and pressures. His figures show that the steam consumption of a 4,000 to 5,000-hp. turbine-driven locomotive would be between 45,000 and 55,000 lb. per hr. instead of the usual 100,000 or more required by the reciprocating locomotive. These steam rates are without extraction. With extraction, even lower rates are possible.

Auxiliaries

At boiler pressures of 600 lb. or more, the standard locomotive feedwater procedures are not necessarily applicable. The injector is out because of the high pressure and because of the feedwater heaters necessary for economical operation. Centrifugal pumps require high rotative speeds which dictate a steam turbine or electric drive. Unless the locomotive is turbo-electric, the electric drive would necessitate unnecessary complication. A small turbine drive is not very efficient and the efficiency of a centrifugal pump is also rather low over a wide range. However, a piston type displacement pump has high pumping efficiencies, can handle hot water close to the flash point, and turn at low speeds. To get variable flow to parallel steam flow, it is better to use a type of pump that has a variable stroke so that the driving motor can operate at constant speed. Several manufacturers make this type of pump for ship board and power-plant use. It operates from zero to full capacity by a simple remote control device. It could be driven off the main engine or off a modern, simple, enclosed, pressure-lubricated, reciprocating steam engine operating against sufficient back pressure to utilize its exhaust for feedwater heating above 212 deg., thus saving most of the heat in the steam used for driving the pump.

The auxiliary feedwater pump should be simple, inexpensive, rugged, and foolproof. A direct-acting steam pump meets these conditions. There are several makes of pumps on the market which operate up to 1,000 lb. on the water end and 250 lb. on the steam end which can readily be reduced from the boiler pressure. Since this pump operates only in an emergency, its relatively high steam consumption is unimportant.

Direct-acting steam-air compressors are relatively expensive, wasteful of steam and increase standby losses. If a standard type of compound air compressor, mass produced for industrial uses, were driven off the feedwater pump engine or by an electric motor, much steam could be conserved and cost and maintenance reduced.

Feedwater heating is important since it vitally affects the overall thermal efficiency and quality of feedwater.

The first stage of heating up to 212 deg. should be in a thoroughfare open spray type deaerating feedwater heater through which the exhaust steam from the main engine passes. Its advantages are the small space required, the fact that it is unaffected by motion, ease of cleaning, ability to bring feedwater up

* *Railway Mechanical Engineer*, May, 1948, page 239.

to within 1 deg. F. of steam temperature, deposition of solids, and effective deaeration. The second stage heating would be, of necessity, an induction type closed heater receiving steam from all auxiliaries at a pressure sufficient to condense all the steam (about 50 lb. per sq. in.).

The remaining stages would be similar to the second stage, except that they would get steam from extraction points on the turbine if used.

The usual flue gas type of air preheater as used in power plants would be too bulky and costly for locomotive use, but if the exhaust steam, after passing through the feedwater heater, were put through a simple tubular air preheater, many advantages would result. It would be simple, small, devoid of soot problems, would require no moving parts, and, being a thoroughfare type, would not freeze in cold weather since there would always be more steam than is necessary to heat the air. The advantages are increased overall thermal efficiency, increased combustion efficiency, better steaming in cold weather, air to the furnace always at the same temperature, and return of condensate to the make-up water, thus increasing water mileage still further.

The main throttle should be air operated as a function of steam-chest pressure. With such an arrangement the engineman, by turning a small knob or lever, can set the pressure at the engine at any predetermined amount. This, in effect, sets torque. As soon as the engine is under way, the throttle would be opened wide and the speed controlled by cut-off alone.

Initial Cost

The initial cost of a locomotive as herein described is difficult to arrive at without a complete detailed analysis. However, the important item to note is that such a locomotive can readily be standardized and mass produced. Like the Diesel, it could be resolved down to speeds of 60, 80, 100, and 120 m.p.h. and horsepowers of 4,000, 6,000, 8,000 and 10,000. Once such a grouping were established, costs could be reduced to match the standard low-pressure steam locomotives which are about half the cost of a Diesel.

Conclusion

The final decision as to type of drive, arrangement of equipment and wheel arrangement would rest with those men versed on the problems involved. We do know, however, that an efficient engine is now available and, as this article points out, a far superior boiler and burner is within our grasp.

It is also of further interest to compare the locomotive herein described against the list of objections usually associated with the standard reciprocating steam locomotive:

Poor coal—Pulverized coal burners successfully burn even slack.

Weight per horsepower—High-pressure water-tube boiler and weight concentrated on drivers all reduce weight per horsepower.

Water stops—High pressure and proper steam utilization cut water rates in half.

Ash disposal—No wheels under firebox allows for ample ash pans.

Heating of journals—Reduced with four cylinders and eliminated by the use of anti-friction bearings. No reciprocating journals with turbo-electric drive.

Packing-gland leaks—Aggravated by high pressure, but poppet valves eliminate valve-stem packing and metallic rings for piston rods help. The turbine eliminates this problem.

High center of gravity—Substantially lowered by the underslung carriage and the water-tube boiler.

Track stress—Considerably lighter reciprocating parts with four cylinders (two separate sets of drivers). Reduced as low as any other type locomotive with turbine drive either geared or electric.

Servicing en route—Cut in half or better by halving water and fuel consumption and, in the case of the reciprocating engine, anti-friction bearings and reduced reciprocating weight.

Acceleration—Slow starting overcome in the case of the reciprocating engine by infinitely variable cut-off; turbo-electric comparable to Diesel.

Availability—Due to use of standard industrial type air compressor, feed pumps, etc., maintenance is reduced and replacement simplified. The water-tube boiler is far simpler, more rugged and far safer even at elevated pressures. (No flat surfaces and no drums are exposed to hot gases. No stays, etc.)

Cold weather—The engine, as outlined above, would be enclosed like the Diesel locomotive. This means that all auxiliary equipment is inside and not exposed to excessive cold. The boiler with its induced draft fan and air preheater would be almost independent of outside temperature.

In short, there is a boiler which fulfills the necessary requirements which, when combined with other available equipment, will produce a vastly superior steam locomotive capable of out-performing all other types of prime mover locomotives at less cost per mile.



Seaboard Air-Line photo

C. & N. W. Intensifies Inspection of Equipment Parts

THE nondestructive testing methods, commonly known as magnetic particle and fluorescent penetrant methods, are used on the C.&N.W. for the testing of parts when new or when removed from equipment for any reason. The test equipment is basically as furnished by the Magnaflux Corporation and up to the present time 18 installations have been completed at the major and secondary shops of the North Western, as well as daily maintenance points. This establishes a pattern on the system whereby all points are equipped with inspection facilities and eliminates any need of placing parts in service that have not been examined for defects or potential failures.

Monthly mileages are piling up to new totals under modern operating conditions, and less rolling stock is standing for long layovers between runs. Higher speeds are demanded of railroad operators and the equipment is subjected to far heavier service than was the case when it traveled less than half the distance. Much of this mileage is also at faster speeds,

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By V. C. Barth*

as compared with earlier performances. When it is realized that two Diesel-electric locomotives operating on increased daily mileage are doing the work of as many as six of the older locomotives, it is obvious that such efficiency must be backed up by the most complete and thorough system of material inspection available.

In the newly-constructed Chicago Diesel shop, two Magnaflux units have been installed for the inspection of Diesel-electric locomotive parts, with a third unit being made available further to supplement this work. Figs. 1, 2 and 3 show the XAN type, magnetic-particle-inspection unit, using Magnaglo for fluorescent indications under a black light, installed in the small-parts room and providing both circular and longitudinal magnetization to handle the smaller parts such as pistons, liners, piston carriers, wrist pins, connecting rods, baskets, rocker arms, bolts, etc.



Fig. 1—Magnaglo inspection unit installed at C. & N. W. Diesel shop

The unit is powered with an external KC-3 power unit, which is portable and can be transferred to operate with the dry powder inspection on larger parts which cannot be conveniently brought to or tested in the Type KAN unit. The fluorescent magnetic particle inspection method has many advantages to locate defects in irregular shapes, sharp changes of sections, between threads, inside of coil springs and bores, and lends itself to faster inspection with greater effectiveness through controlled sensitivity. Further, the color pattern of any defect indication which fluoresces when viewed under the black light is in sharp contrast with the background. This greatly decreases the danger of overlooking any unsound condition.

To supplement the inspection further, a Type XR-192 Magnaflux unit, powered with an external portable Type KC-5 unit, employs the wet Magnaglo magnetic inspection for the examination of the heavier Diesel and steam locomotive parts, such as axles, axle gears, traction motor shafts, pinion gears, crankshafts, cam shafts, cylinder heads, etc. It provides both circular and longitudinal magnetization, and will accommodate parts up to 192 in. in length between contact plates, and up to 24 in. in diameter in the magnetizing coil. This fluorescent magnetic particle inspection method was found to be particularly adaptable for examination and detection of thermal cracks, such as frequently found in journals, and minute fatigue cracks in traction gears at the root of the teeth.

Fig. 4 is a typical Magnaflux Zyglo ZA-12 unit, using the fluorescent penetration inspection method, installed in the new Chicago Diesel Shop essentially for the inspection for surface defects in nonmagnetic materials such as Diesel engine valves, valve seats, valve heads, aluminum pistons, etc. It provides for the total immersion and soaking in a special penetrant which has the properties of penetration into defects or faults. The excess surface film of penetrant is rinsed off with water and the part subsequently immersed in a water emulsion of the developing material. The parts are then dried and examined under the black light where any defect will fluoresce in brilliant contrast to the flawless surface. Its application is now being extended for the examination of bearings, non-magnetic tools, bolts, etc.

All Diesel locomotive parts are inspected when removed from service for any cause and at the usual inspection periods involving general or partial disassembly. Referring to the table, it will be noted that salvage is generally not attempted on Diesel parts found to be cracked. Since many of these parts operate for such a long period between overhauls, it is felt to be safest and most economical to scrap parts containing any defects.

A few years ago it was agreed that the Magnaglo magnetic particle inspection method would be best suited for use in inspecting car axles where speed is essential because of the volume now required to be inspected, and where a sharp contrast is desirable because of the nature of defects commonly found in axle journals, such as thermal cracks and copper penetration. Fig. 5 shows a typical installation at the



Fig. 2—Set-up for inspecting Diesel pistons, liners, piston carriers, wrist pins, rocker arms, etc.



Fig. 3—Magnaglo inspection of a Diesel-engine connecting rod

Chicago wheel and axle shop where about 90 axles must be processed daily to satisfy the demands. This unit is the Type XRTL unit, powered with an external Type KC-3 unit, employing the wet Magnaglo bath, and especially designed to handle car axles on a production basis. While two of these units are in service on the system, other units employing the dry powder method are also in service to supplement the inspection of car axles, hangers, truck sides, draw bars, equalizers, etc.

All streamline and conventional passenger car axles are inspected each time removed from service for wheel turning, or any other reason, and with races removed on roller bearing axles. Freight car axles



Fig. 4—Ziglo Equipment for inspecting non-magnetic parts such as valves, valve seats, aluminum pistons, etc.

C. & N. W. MAGNAFLUX INSPECTIONS DURING ONE TO THREE-MONTH TEST PERIOD

	Number of parts inspected	Per cent* defective	scrapped
Car axles	2,307	8.02	4.12
Steam locomotive machinery parts	4,645	3.59	3.03
Diesel locomotive parts:			
Connecting rods	167	5.39	5.39
Wrist pins	148	6.75	6.75
Piston carriers	196	8.11	8.11
Baskets or bearing caps	50	4.00	4.00
Pistons	310	3.87	3.87
Rocker arms	61	6.56	6.56
Valves	688	2.33	2.33
Valve heads	132	1.51	1.51

* The difference between per cent Defective and Scrapped represents the per cent salvaged and returned to service.

are inspected when in the shops for any purpose. The critical locations on these axles are predominantly in the journal and wheel seat, as well as under the pulley drive. Axles with wheels mounted are inspected on journals and between wheel seats, while those without mounted wheels can be inspected from end to end. As may be seen by reference to the table of inspection records, considerable salvage is possible for defects located in car axles, especially by machining until shallow defects are removed while the axle is still within acceptable size limits.*

Steam Locomotive Inspection

In 1940 the first Magnaflux inspection unit was installed in the Chicago locomotive shops for the inspection of steam locomotive parts. Fig. 6 shows this installation employing the Type KR-3 unit for power, the Type XB-2A powder blower, and a work table designed in our shops for the handling of the various parts by the dry powder method. The table is equipped with three outlets permitting the use of three short cables with either-end connectors on both

* High speed roller bearing passenger-car axles are scrapped.



Fig. 5—Set-up for Magnaflux inspection of car axles on a production basis

ends for the wrapping of coils at three locations on the work, however, only one is energized at a time. This permits the use of less cumbersome cables, and with the use of the mechanical powder blower greatly facilitates the inspection operations. Seven such installations are in service at major shops on the system. The power unit, being portable, can be moved to work such as driving axles, pins (mounted), wheel centers, etc., while the motion parts such as main and side rods, piston rods, crossheads, valve motion parts, radius bars, crankpins, crank arms, spring hangers, etc., can be conveniently handled on the work table.

All side and main rods are inspected at the time of the quarterly inspection, and all motion work at the annual inspection. When steam locomotives are put through the back shop all motion work and machinery is thoroughly inspected.

The importance of finding small fatigue cracks cannot be too strongly emphasized as these contribute to potential and unexpected costly service failures. Such cracks are commonly found in notches or blemishes from numerous causes such as injury in handling, scratches, abrasion and nicks. Many fatigue cracks have their origin in sharp changes of section or contour such as in keyways, splines, thread roots, juncture of shank to head in bolts and studs, and in grease or oil holes. Other fatigue cracks are frequently found to be directly due to marks caused by grinding, filing, tools, sharp stencils, forging laps and other similar defects. When these cracks are found in locations free of the above conditions, they are due to design, material or service conditions.

To reduce the above type defect to a minimum, injury to steel must be avoided, hammer, tool and grinding marks eliminated, and when found the removal of sharp edges and polishing is imperative. Small cracks considered inconsequential may be ground out allowing a liberal fillet at the edges and polishing the entire ground surface. Design changes eliminating sharp corners or edges must be made from time to time where repeated failures occur due to required service conditions.

Capable and well-trained inspection operators are of vital importance for a good inspection to be car-

ried out. In this connection it is important that inspection supervision follow the operations closely, by study of inspection reports and by regular and thorough check-up on each inspection location.

When an inspection unit is installed a manufacturer's representative and a technical staff member from the testing department instruct the supervisor in charge and two mechanics on methods of operation. Descriptive bulletins supplemented by a verbal description of operations and actual parts inspection comprise the instruction procedure and when instructed personnel are transferred to other duties, requiring the assignment of new operators, a member of the technical staff carries out the instruction of the new men along the original lines. This was found to be of utmost importance, particularly where new assignments are made frequently. Experience has shown that instructions issued by a former operator are usually incomplete and lead to inferior inspections.

The operation of the equipment and the inspection is performed by shop mechanics, assisted by mechanic helpers, who are thoroughly trained and instructed by the staff of the chief metallurgist and engineer of tests. The technical staff examines typical defects, determines the cause and advises on corrective measures for prevention of recurrence if possible, and decides if defective parts can be reconditioned for further service. It is the objective ultimately to eliminate service failures that fall into this category; and to insure the quality of materials placed in service.

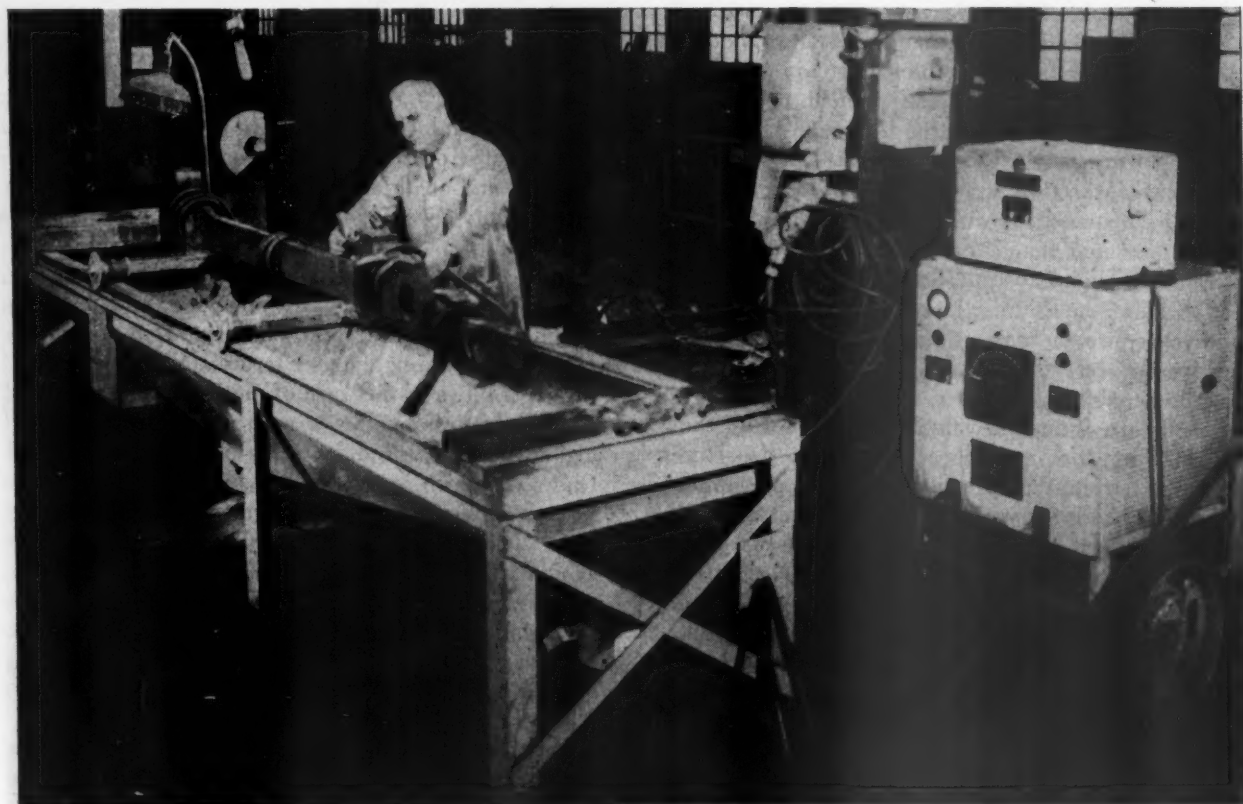


Fig. 6—Standard C. & N. W. work table for Magnaflux testing of steam locomotive parts

EDITORIALS

Little Things Can Cause Big Results

Three men were killed recently operating a locomotive in revenue freight service as a result of a multiple-guide crosshead wrist pin working out because the nut and lock nut had not been properly tightened after the rods were removed at the regular monthly inspection.

The rods had been removed from the locomotive at the inspection just prior to the accident, and part of the needed rod work done when it was decided to place the locomotive on the drop pit for trailer wheel work. In order to move the locomotive from its existing stall to the drop pit, the right wrist pin was replaced. The pin was applied temporarily by hand, putting on the nut but not the lock nut, because the locomotive was to be spotted later for rod and knuckle-pin bushings. The machinist who made the temporary wrist-pin application was then transferred to other work. Before leaving the locomotive, he stated that he had, as a precaution, made a notation on the cylinder jacket that the wrist pin was loose. The jacket, however, was later painted.

It later developed that the rod and knuckle-pin bushing work originally planned was not necessary. The usual inspection was given to the locomotive before dispatchment, at which time the crosshead pin was tapped and found to be tight. The work report items were signed for and the report certified. After the accident, the cylinder jacket paint was scraped off, and yellow crayon marks found thereon; these marks apparently were those made by the machinist, and had been painted over.

The above example is valuable in that it shows how a series of comparatively insignificant departures from the strictest observance of safety precautions can lead to serious trouble. It is somewhat of a railroad equivalent to the old fable that tells us how a kingdom was lost for want of a nail. No extreme carelessness appears to have been involved. It is, of course, always far easier to add up a series of occurrences and picture whether the end result is good or bad by hindsight than it is to predict the result by foresight.

Certain assumptions were made during the inspection that caused the improperly applied crosshead wrist pin to go unnoticed. The crayon marks that indicated the loose pin were overlooked. Some work

report items were signed for, and the report certified, without the signer having personally performed every detail of the job, or having personally witnessed the completion of every detail of each item in the overall report.

It is for this reason that the above accident can serve as a useful example to all concerned with locomotive maintenance. Practical considerations of providing locomotives to keep trains running often make it difficult for supervisors to be able to check every detail of maintenance because of the many demands on their time. There are times when assumptions are made on which the odds against their causing any trouble are great. It is well to remember, however, that, while the odds against anything happening are big, the consequences might be serious in the event that the unlikely does occur. Supervisors might therefore do well to call the above example to the attention of the working forces under them with the thought that it may help to prevent a similar accident on their railroad.

Roving Locomotives

Diesel-electric locomotives are in some cases now being operated over extended territory, going over the division and on to another and another, perhaps returning only once a month to their point of departure for monthly inspection. In this type of service, they might be likened to the tramp steamers of the sea. It is certainly a far cry from the manner in which steam locomotives have long been used, and with adequate planning, it permits the user to take full advantage of the capabilities of this type of motive power.

The practice involves a new set of circumstances and suggests the need for some changes in practice. One road which is using locomotives in this kind of service employs riders which may be mechanics or electricians. This insures adequate daily inspection, avoids failures or delays due to such minor faults as a bad electrical connection or improperly operating relay and takes care of a certain amount of running maintenance. It has been found that such riders frequently anticipate and prevent trouble which would develop into costly repairs.

Perhaps the practice of using locomotives in this manner is a natural outcome of installing locomotives faster than maintenance facilities for the locomotives can be provided. Diesel-electric locomotives are still

a new thing to railroad operators and there are still many conflicting opinions concerning what maintenance facilities should be provided. It is conceivable that as such facilities are provided, in more and more places, no locomotive will ever be very "far from home"; never a great distance from some point capable of restoring the locomotive to service after any kind of failure.

On the other hand, the use of roving locomotives carries with it the suggestion that *major* overhaul and inspection points may be pretty far apart. The Diesel-electric locomotive is a highly dependable device. It should be possible to increase this dependability and as this is done, service requirements are bound to change. Many new service facilities are needed right now, but in providing them some long-distance planning is indicated.

Planned Car Maintenance

One of the major stumbling blocks to effective and economical railway car maintenance, particularly freight equipment, has been the inability of car officers in many cases to forecast mechanical conditions and plan program car repairs on a uniform production basis, uninterrupted by business fluctuations and attendant force changes. The latter part of this limiting condition will probably always exist in railway operation, but can be ameliorated if car supervisors insist and persist in proving to their superior officers how much it costs in many different ways to curtail operations and lay off men. The attendant loss of morale, reduced unit production and cost of training new men when shop operations are again expanded may well, over the years, go far to offset temporary savings in pay roll expense.

The need of accumulating data and making field inspections of car series which will require general repairs, say within the next 12 months, in order to avoid an epidemic of service failures, arrest progressive deterioration and restore service mileage has been commented on many times at meetings of the Car Department Officers' Association, and the various car foremen's associations throughout the country. Whereas a shopping period of four to eight years for various classes of cars was formerly considered the most acceptable range, the present tendency is to reduce the maximum period to seven years in view of higher operating speeds and increased severity of service. Caboosees naturally require a higher standard of maintenance and, for this type of car, the suggested service period between classified repairs is two to four years.

The setting up of heavy repair programs well in advance, not only permits scheduling the work to avoid peak requirements in any one year, but permits planning material deliveries, the installation of labor-saving machinery and devices, and also the

assignment of forces necessary for carrying out of the work most efficiently. In this connection, the selection of specific shops for repairing certain classes of cars is obviously of great importance, the locations being chosen to minimize back haul and permit assigning cars to shops which specialize in the respective types.

Before embarking on program repairs for a given series of cars, one idea which seems worth more extensive use is to select a typical sample car and give it the necessary repairs, making a fairly complete record of new materials required and the detailed time and labor involved. On the basis of this information and considering any desired weekly or monthly output, both material and labor requirements may be forecast with accuracy and cost figures kept within desired limits.

This method of planning repair programs well in advance also permits fabricating many detail car parts with full advantage taken of quantity production methods, which not only reduce unit costs but assure car materials being available when and where needed as the repair work progresses. The reuse of car parts which may be repaired or reclaimed is an important element of the overall material supply problem. This work is generally best done at central reclamation plants where individual railroads have the specialized experience and equipment necessary for reclaiming parts only when it can be done at a profit.

Training Men For Diesel Maintenance

With the increasing numbers of Diesel-electric locomotives that are in service today, the railroads are faced with a number of difficult problems with respect to their maintenance. Not the least of these problems is the ability to secure enough of the right kind of men to perform the operations in Diesel servicing and maintenance shops. There is a definite shortage of trained Diesel maintenance men and in spite of the fact that the builders have set up rather elaborate training school facilities which take care of the job of introducing to supervisors the general nature of maintenance work with which they must contend on the new type of power, the real job at present and for some time to come, will be that of training the rank and file in a new type of work. Most of the men that make up the roster of a Diesel shop have been mechanics, electricians and helpers who have worked on steam locomotives. The suggestion is made that because of the "crude" nature of maintenance work on steam locomotives, men who have done this kind of work are not particularly adapted to the more precise work required on Diesel-electric locomotives. We cannot agree entirely with this assumption for over a

period of years the railroad shop has had the reputation of having a high-grade group of mechanics. A good mechanic is a good mechanic and there is no reason why he cannot do as good a job on a Diesel-electric locomotive as he can on a steam locomotive if he has the desire to do it and has been properly trained to do it. It is possible that most of the difficulties some roads are having with Diesel maintenance men are being experienced because their work is somewhat of a mystery to them and the road has not made an adequate effort to instruct them in what is expected of them.

The Diesel-electric locomotive, both from a mechanical and an electrical standpoint, is an intricate machine and there is no reason to expect that as the units now in service grow older their maintenance cost will not increase considerably. Just why any chief mechanical officer can assume that an adequate Diesel inspection and maintenance force can be built up without a comprehensive instruction program is difficult to understand. Most of the large roads, at least, have done a reasonably good job of setting up instruction classes and, in many cases, instruction cars. It would seem logical at this time to look upon the expense of instruction programs as a charge to insure that future maintenance costs are held within reasonable limits.

Some of the difficulty at present seems to be the reluctance of many men to attend instruction classes on their own time. In as much as an adequate maintenance job can not be done without training programs and training programs fail of their complete objectives if any large part of the maintenance personnel fails to take advantage of them, it appears logical that the railroads must take an extremely practical view of this phase of the Diesel maintenance program and find out whether or not the high cost of a mediocre maintenance job can be entirely justified in the light of what may be a relatively modest expenditure for setting up a training program and making sure that the proper personnel take part in that program even if they have to be paid for doing it.

NEW BOOKS

WELDING AND CUTTING MANUAL. *Published by The Linde Air Products Company, a Unit of Union Carbide and Carbon Corporation, 30 E. 42nd street, New York, N. Y. 208 pages; 6 in. by 9 in. Price, \$1.80.*

This new handbook on the oxy-acetylene process should be useful as a reference and instruction book for anyone who does welding and cutting. The style is easy to read and instructions are given in step-by-step photographs of actual repair jobs. This book is

an excellent guide for the beginner because of the clarity with which the operations are presented by the text and the illustrations. It can be used as a lesson book by starting at the beginning and following through on each succeeding job. Chapters give instructions and short-cuts for bending and straightening metals, bronze welding, soldering, hard-facing, cutting steel and cast iron, heating, forming, welding and cutting pipe, and welding non-ferrous metals. In addition, an appendix contains useful charts and tables, a complete glossary of welding terms, and a list of 100 repair jobs with recommended welding methods.

HEATING, VENTILATING, AIR CONDITIONING GUIDE, *Published by American Society of Heating and Ventilating Engineers, 51 Madison avenue, New York 10. 992 pages exclusive of catalog section of 381 pages; 6 in. by 9 in.; Price \$7.50.*

This, the 1949 issue, is the 27th Edition of this Guide, covering current engineering practice and recently published data in the field of heating, ventilating and air conditioning. Of the 51 chapters comprising the seven sections of the Guide all have been examined for necessary changes and extensive revisions have been made to 19 of the chapters. While only relatively small space is devoted exclusively to railroad installations the basic information throughout the entire book is applicable to railroad car and shop building installations. The catalog section is likewise of value in its presentation of technical data on the products of many manufacturers which serve this industry.

WELDING METALLURGY (IRON AND STEEL). *Second Edition. By O. H. Henry, Professor of Metallurgical Engineering, Polytechnic Institute of Brooklyn, and G. E. Claussen, Metallurgist, Reid-Avery Company, Baltimore, Md. Revised by G. E. Linnett, Senior Research Engineer, Armco Steel Corporation, Baltimore, Md. Published by American Welding Society, 33 West 39th street, New York 18. 505 pages; 5 in. by 7¾ in. Price, \$2.50.*

This 1949 edition includes new information on processes such as inert-gas metal-arc welding which have been introduced during the last eight years. It contains more information on the metallurgy of specific materials such as the stainless, heat-resisting and stainless-clad steels. Beside welding, the book deals with the basic theory of the metallurgy of iron and steel and the effects of alloying elements. The book discusses simple welds, shrinkage, preheating and postheating, welding of plain and low-alloy steels, and the welding of stainless and heat-resisting steels.

A short bibliography has been added to each chapter to suggest sources of additional information on each subject. Questions on each chapter are included at the end of the book for use in schools or for home study. The book contains 203 illustrations.

CAR INSPECTION AND REPAIR

Hopper Cars Converted From Tank Cars



THE Thrall Car Manufacturing Company, Chicago Heights, Ill., has just completed a program of converting eleven tank cars into Class LTA 50-ton hopper cars which are 98 per cent self-clearing. The original cars were Class 3 TM 10,000-gal. tank cars built in 1920 with $\frac{3}{8}$ -in. top sheets and $\frac{1}{2}$ -in. bottom



The hoppers are prefabricated before being welded in place

sheets. After conversion to a design by the Barrett Division of Allied Chemical & Dye Corp., New York, the cars will be used to haul roofing stone. Because of the unit weight of this lading, the cubical content of the tank is sufficient to carry full loads.

After cleaning and stripping, the tank is removed from the car and all work done upon the tank while it is off the underframe. This comprises removal of the dome, outlets and tank anchors, cutting and applying the three top hatches, welding the two slope cross ridges in place, and applying the three hoppers. The slope sheets were welded in place with their tops 12 in. below the inside top of the tank. A 3-in. inspection hole was installed in each end.

The original center sill comprised two 15-in. channels joined by cover plates. This has been reinforced with two 9-in. channels riveted to either side of the sill from body bolster to body bolster. This serves both to strengthen the center sill and to compensate for cutting through the cover plates to make room for the hoppers. The cover plate now extends from the end sill to the outside end of each hopper, and between the end hoppers and the center hopper only. Additional under-tank frame reinforcement is furnished by a section of boiler plate $\frac{1}{2}$ in. by 24 in. by 66 in. welded inside the tank in place directly



The reenforced center sill and the discharge arrangement — Below: Interior details of the hopper car

over each body bolster to support the tank.

The tank anchors and the seams where the hopper fits to the tank are riveted joints; otherwise all joints are welded. A $\frac{3}{4}$ -in. rod is applied around all joints and at the top and bottom where the slope sheets join the cylindrical tank to facilitate the welding of the joints. The slope sheets, which are $\frac{3}{8}$ in. thick, are reinforced by angles $\frac{3}{8}$ in. by 3 in. by 3 in. Six such angles are used for each end slope sheet. One pair extends from the approximate vertical center of the slope sheet straight down to the bottom of the tank, a second pair from the vertical center of the slope plate to the bottom part of the joint between the tank bottom and the end section, and one pair is welded along the underneath side of each slope sheet. There is also one angle that extends crossways across the slope sheet at the vertical center. The distance between the angles is 29 in. The two pairs of supporting angles are fastened at their lower ends to the tank bottom by gusset plates $\frac{1}{2}$ in. by 6 in. by 12 in.

Each of the three top openings are elliptical shaped and approximately 16 in. wide by 60 in. long. The frame for the top opening is made from an angle section $\frac{3}{8}$ in. by $3\frac{1}{2}$ in. by 6 in. preshaped and welded in place after the top cover openings have been burned out. Top sections $\frac{1}{4}$ in. by 20 in. by 64 in. are fastened to the openings through hinges and locked in place by inserting a pin through a hasp.

The hoppers are completely preassembled and applied as a unit. They are made from $\frac{1}{4}$ -in. steel plates cut to shape on shears and welded together to form the finished hopper. The hopper opening frame is $1\frac{1}{8}$ in. by $13\frac{1}{4}$ in. by $16\frac{1}{4}$ in. outside and is also welded in place. After the hopper is welded in place to the tank three bars $\frac{1}{2}$ in. by 4 in. by 15 in. are welded across the top of the hopper further to secure it in place. The hoppers are operated by spur gears with the track welded to the bottom of the



hopper slide; the gears are held in place by two formed brackets $\frac{1}{4}$ in. by 16 in. by 12 in. welded to sides of hoppers.

Two cross-ridges were welded in place between the center hopper and each of the end hoppers. These vary slightly in width, one being about 9 in. and the other 11 in., as well as in height, one being

5 in. and the other 7 in., because the center hopper is separated from one end hopper by 12 in. and from the other by 15 in. This was necessary in order to have the center hopper discharge at the center of the car. As the cross section of the hoppers is not completely symmetrical, one edge of the center hopper is closer to one of the end hoppers than the second edge is to the second hopper.

In addition to converting the tank cars to hopper cars, other miscellaneous work was performed such as the application of AB brakes, a new wooden top running board, new center tank anchors, and the replacement, where necessary, of miscellaneous underframe members. Considerable use, however, was made of existing parts, such as the original side running boards, tank bands, handholds, couplers and draft gears.

The color scheme of the converted cars is a distinctive red background with all stencilling in aluminum. The bottom sheets and underframe are conventional black.

Decisions of Arbitration Cases

Stamping Required When Truck Sides Welded

On April 15, 1947, the Texas & Pacific removed, repaired and replaced two unit-type cast steel truck sides, position A.R.&L., on Pacific Fruit Express Car No. 64997, as the truck sides were cracked, owner's responsibility. The two truck sides were removed, welded and annealed as provided for in Interchange Rule 23, but the T. & P. failed to stencil the sides as provided for in this rule. The truck sides were re-applied to the car, and the car was released for service and bill rendered versus P.F.E. The P.F.E. had car 64997 on its repair track on April 28, 1947 when the two truck sides were removed and new ones applied as those removed were not stencilled as per Section A-7 of Rule 23.

On November 18, 1947, the P.F.E. submitted a joint inspection certificate to the T. & P. covering the two welded, but unmarked, truck sides. The T. & P. issued a defect card covering the incomplete repairs, which the P.F.E. used as authority for rendering a bill of \$128.95. The T. & P. refused to pass the bill for payment stating that the repairs were originally performed because of owner's defects and they did not feel that their defect card justified the P.F.E. in applying two new truck sides.

The P.F.E. felt that the charge for the application of the sides was strictly in accordance with the rules as provisions of Section A-7 were not complied with.

The statement of the T. & P. contended that the cracked sides occurred in fair usage, and that the railroad had the right to remove them at P.F.E.'s expense, and to apply new sides. The T. & P. welded the sides instead, and felt that the sides were at least

in no worse condition after welding, even though incomplete repairs were made. The T. & P. also felt that the most they could be consistently requested to do would be to cancel the charges for the incomplete repairs, which they agreed to do.

The P.F.E. contended that the information furnished by the T. & P. was conflicting in that the T. & P. said that the side frames were electric welded and annealed as per Rule 23, whereas the rule requires welded frames to be normalized. The P.F.E. attached the T. & P. defect card to the P.F.E. billing repair card and included a charge of \$128.95 for correction of wrong repairs in P.F.E. bill of \$417.95.

In a decision rendered April 7, 1949, the Arbitration Committee ruled that the T. & P., failing to comply with Par. 7 of Sec. A of Interchange Rule 23, should cancel charge for welding the two truck side frames. The contention of car owner was not sustained as to charge rendered for renewal of truck side frames. *Case 1831, Texas & Pacific versus Pacific Fruit Express.*

Handling Car Parts on the L. & N.

The four devices shown here were developed by shop personnel at the South Louisville, Ky. car shops of the Louisville & Nashville for simplifying the work of removing, transporting or applying car parts.

Dolly for Air Brake Equipment

A two-wheeled dolly is used for carrying and supporting air brake reservoirs for application to the car. The dolly moves on a pair of 25-in. wooden wheels set 18 in. apart. It has a handle 5 ft. long with a cross bar 18 in. long at the end. The other, or load-carrying, end is so formed that parts are rolled directly onto the dolly where they are held in place for movement by the concave shape of this end. The cart is made up of tubing 1½ in. outside diameter supported where necessary and joined by angles ¼ in. by 6 in. by 14 in.

In hanging reservoirs the dolly is maneuvered to



place the reservoir in the holding bracket on the car. While the reservoir is held in this position the bolts can be applied and tightened by one man while a second man takes the strain off the bolt by holding down the handle of the cart. Cylinders and triple valves are applied in similar manner.

Skid for Couplers

Six couplers may be hauled safely and conveniently on a single lift truck by means of a holding attach-



ment shown. This device is a U-shaped skid, with channels extending outward from the bottom of each leg. The couplers rest in these channels and are held by iron straps $\frac{3}{16}$ in. by 2 in. The table of a lift truck fits between the channels to carry the load of couplers.

The channels are made from sheet steel. They are $\frac{1}{4}$ in. by $2\frac{1}{2}$ in. by $10\frac{3}{4}$ in. by $13\frac{1}{2}$ in. in cross section and about $51\frac{1}{2}$ in. long. Two spacers are installed on each channel to position the couplers properly; these are made of angles $\frac{1}{4}$ in. by $2\frac{3}{4}$ in. by $2\frac{3}{4}$ in. Spacer channels made of scrap brake beams are installed at the ends and at the center to join the main channel portions together. These channels also form the top support of the coupler skid by which it is lifted and carried by the lift truck.

The distance between the inside edges of the two main channels is 32 in. Near the center of the small channels which extend across the ends are bolt holes through which bolts secure the iron straps which hold the couplers in place, and which permit the straps to swing in and out of position for holding the couplers.

Truck for Steel Panels

A two-wheel cart designed to carry side and end panel sheets for freight cars is used to transport these and other miscellaneous large steel sheets where cranes are not available. The bottom and rear frames are made of a 6-in. 12-lb. channel. An angle iron $\frac{3}{8}$ in. by 2 in. by 2 in. is welded to each side of this channel at its extremities. The sheets thus rest on the channel and are held in proper vertical position by the angles. The side braces in the center of the cart are made of a 3-in. 7.1-lb. channel. The other braces are plates $\frac{3}{8}$ in. by 3 in. The top channel



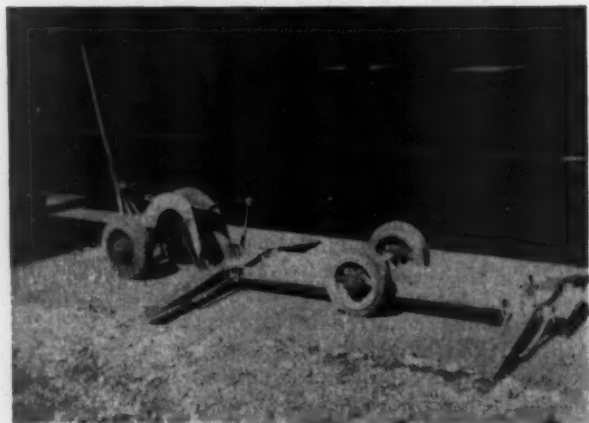
extends about 1 in. beyond the load-carrying portion of the cart, and to the extension is welded a handle, which is $1\frac{1}{2}$ in. by 21 in.

The cart is used by locating the open end near a stack of sheets, and placing a piece of wood 4 in. by 4 in. under this end. The sheets can then be easily slid onto the cart, which is normally used to move three or four $\frac{3}{8}$ -in. sheets, the maximum number that can conveniently be pushed. The cart rests on two steel wheels $3\frac{1}{2}$ in. by 29 in.

Mounted Wheel Cart

This four-wheel cart which simplifies the handling of mounted wheels. The cart is fitted with inclined runways for rolling the wheels into position. It travels on two pairs of rubber wheels 3 in. by 12 in. The wheels in each pair are set 17 in. apart, and the two pairs are on 51 in. centers.

The runways over which the wheels are rolled into position on the cart are 3 in. wide and 24 in. long. They are $\frac{1}{4}$ in. thick at the outside end and $2\frac{1}{2}$ in. thick at the inside end to form the proper incline. When the wheels are in place on the frame of the cart the runways pivot to a vertical position on pins $\frac{3}{4}$ in. by 4 in. held in place by cotter keys. A cable arrangement from the handle automatically raises the runways when the handle is lowered for pulling the cart. The body of the cart upon which the wheels rest is made of a 12-in. 35-lb. channel. It is grooved in back of the front incline and in front of the back incline for the wheel rims. The handle is 1-in. pipe.



SHOPS AND TERMINALS

Mounting Wheels With Pins In Place

By J. R. Phelps

It is common railway shop practice to mount a pair of wheel centers on a driving axle by means of a 600-ton wheel press, apply the tires and move the wheels to a quartering machine where crank pin holes are accurately bored with exactly 90 deg. difference in angular position. Crank pins pressed in these holes are then in accurate quarter.

Let us see what happens when the replacement of roller bearings, or other cause, makes it desirable to remove and re-apply driving wheels to the same axle. Normally this involves pressing out one or both of the crank pins in the re-assembled wheels, reboring the holes in accurate quarter and applying new pins, which is an expensive job, especially if the crank pins also are roller bearing equipped.

To overcome this difficulty and save a substantial amount in the cost of maintaining roller bearing driving wheels, the method, illustrated, has been developed and successfully used to re-apply driving wheels on the same axle and have the original crank pins in accurate quarter, that is to say, 90 deg. apart, plus or minus .005 in.

Equipment required for this operation includes two dial indicators, one of which bears against the top and the other the center line of a piece of 3½-in. ground steel tubing screwed into the inner end of the crank pin. The dial indicators are mounted on a 5/16-in. rod

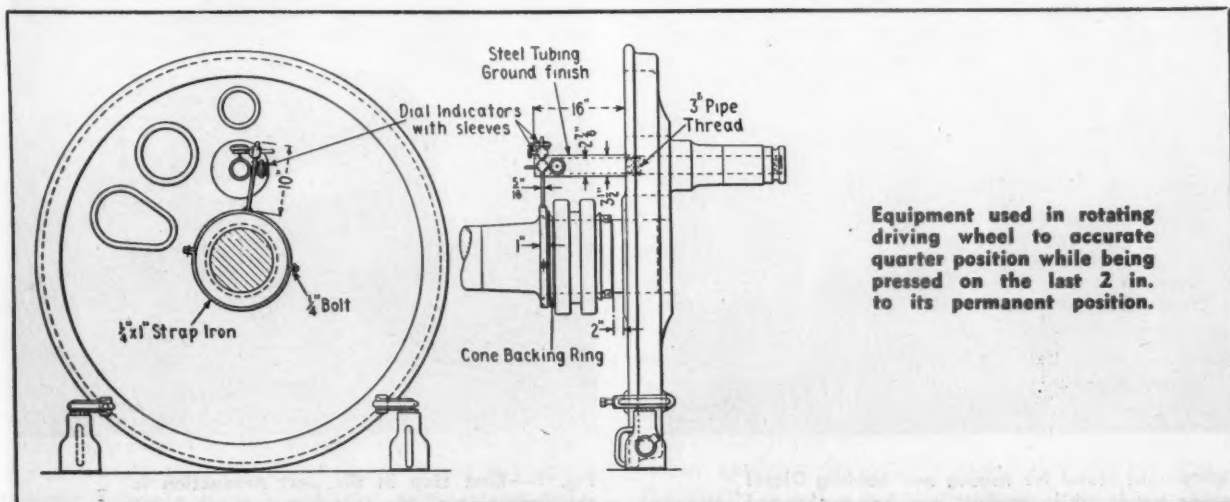
welded to a 2-piece circular band of ¼-in. by 1-in. strap iron which may be easily revolved and clamped in any desired position on the Timken roller-bearing cone backing ring, as shown.

In using this equipment, one driving wheel is pressed on the axle to its permanent position. The second wheel is pressed on, leaving 2 in. still to go and with the wheels quartered as nearly as possible by means of straight edges and a spirit level. The wheels are placed in the quartering machine where the pins are checked for quarter and a notation made of the amount of variation from 90 deg.

The wheels are returned to the press and set as shown in the drawing with two journal jacks bearing against two C-clamps firmly secured near the bottom



Helper operating one of the hand jacks as machinist watches Starrett dial indicator which shows rotation of wheel on axle



Equipment used in rotating driving wheel to accurate quarter position while being pressed on the last 2 in. to its permanent position.

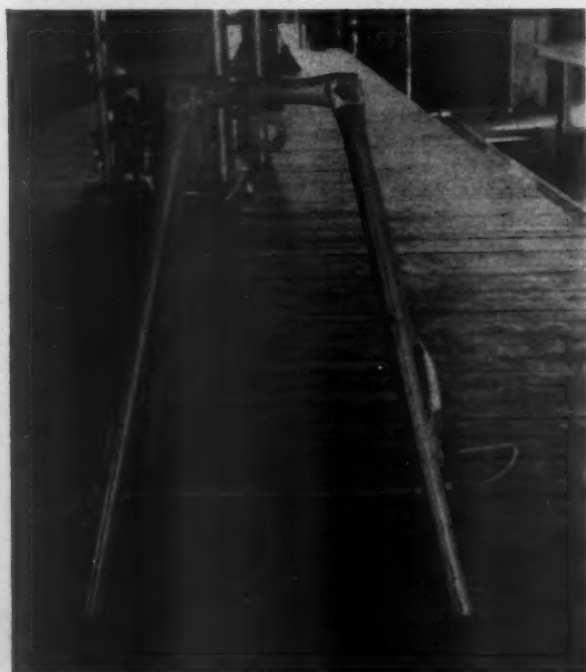
of each tire. A pressure of 75 to 100 tons is applied to the ram of the press and all four jacks tightened lightly. The ground steel tubing is screwed into the crank pin and the gage holder and gages applied as shown. The dial indicators are set and the wheel pressed slowly on the remaining 2 in.

Watching the lower dial indicator, the exertion of more pressure on one jack and lightening pressure on the other will revolve the wheel slightly in either direction desired as it moves on the axle. The exact amount indicated as necessary by check in the quartering machine can be secured within an accuracy of plus or minus .005 in. The dial indicator at the top of the tubing is watched for any indication that the wheel is not going on the axle straight.

Diesel Engine Head Removing Stand

A light simple stand has been constructed by shop forces of the E. J. & E. Joliet, Ill., Diesel enginehouse for mounting on top of the engine to hold a ratchet jack for raising, holding and reapplying the head when gaskets require renewal. The jack is light enough for two men to be able to lift it in place and is wide enough to straddle the hood opening over a cylinder. When in place a small ratchet jack is suspended from the top member for raising and lowering the head.

The stand is constructed of 1 3/4-in. pipe welded together as shown by the illustration. The dimensions across the bottoms of the legs are 27 in. by 31



Lightweight stand for raising and holding Diesel engine heads while gaskets are being changed

in. The eye which holds the ratchet jack is made from 1/4-in. plate, and the re-inforcing rods across the bottom from 3/4-in. round stock.

The stand is particularly useful for changing gaskets as the head can be raised high enough to give the workmen sufficient room to work underneath it. The head can therefore be left hanging from the jack while the work is progressing and merely lowered back into place upon completion of the gasket renewal without any need for further transporting of the head.

Forming Dies Made From Scrap Axles

Converting scrapped locomotive axles into large press dies for forming car parts is a worth-while economy for many railroads. This operation is made possible in the Union Pacific Omaha, Neb. shops by means of forging hammer, flame-cutting, and automatic submerged welding. In general, the procedure is to flatten the axles, trim them, and prepare vee edges by flame-cutting. The next step is to weld a sufficient number of prepared billets together for the particular die being made. The final step is to weld on detailed forming parts for both male and female halves.

Fig. 1 shows the scrap axle that has been heated to about 2,300 deg. F. being flattened under a steam hammer. Desired thickness is controlled by this operation. After the flattening operation, the rough billets go to the flame-cutting department where they are cut to specified size. Billet edges that are to be welded are prepared with the double vee pictured in Fig. 2. This Unionmelt welding shown calls for 1/4-in. rod and



Fig. 1—First step in die part production is the flattening of the axle into a rough billet



Fig. 2 (left): Unionmelt welding is used to make multiple passes in welding together flame-trimmed billets—Fig. 3 (center): Two weldments that have been made from scrap locomotive axles—Fig. 4 (right): Male half of car-part forming die made of scrap axles

proceeds at about 14 in. per min. Using from 800 to 1,100 amp., a.c., the required number of passes are made on each side of this $3\frac{1}{2}$ -in. thick billet.

Fig. 3 shows two semi-completed weldments that are parts of forming dies. The thicker piece on top has been formed from three axles while the thinner slab on the bottom was made from two. Formed weldments of this type have been made up to 100 in. in length, $3\frac{1}{2}$ in. thick, and 50 in. wide. Welding on the reverse side largely corrects any buckle due to the initial welds and the slab is machined without stress relieving.

A male half of a nearly completed die, the principal parts of which are made from locomotive axles is seen in Fig. 4. Using the method outlined here, billets have been made from locomotive axles to make dies for corrugated ends for coal cars, corrugated dump doors, car side posts, spring planks, front and back flue sheets, and many types of face plates.

Device for Handling Units

The task of applying or removing superheater units is simplified where difficulty is experienced in breaking the units loose or in forcing them back into place by an arrangement in use at the Decatur, Ill., shops of the Wabash. The arrangement comprises a jib crane mounted on the front end of the locomotive smoke box and an air winch mounted on a platform supported by horses. The hoist and crane holds the free end of the units in line with the flue for insertion or removal, and the winch, in conjunction with a few auxiliary fittings, forces the units either into or out of position for application or removal.

The jib crane mounted on the locomotive has a cross bar 3 in. by $1\frac{1}{2}$ in. and a 5-ft.-high upright bar 4 in. by 2 in. The hoist travels on a 3-in. I-beam which is mounted to the upright bar by two plates $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $\frac{1}{2}$ in. A bolt 1 in. by 6 in. fits through holes in these plates and through the end



The jib crane mounted on the smoke-box front

of the I-beam which swivels between the plates. The I-beam is about 10 ft. long, and the hoist is of 1 ton capacity. Further support for the load on the chain hoist is given by a 1-in. truss rod from the top of the upright to the free end of the I-beam.

The winch rests upon a wooden platform set at the approximate height of the lower part of the smoke box. To remove the units, a hook on the end of a wire rope fits around the neck of the unit and the winch withdraws it.

For applying the units a rod slightly longer than the length of a flue is pushed through one flue. One



Raising the free end of the units to line them up with the flues preparatory to pulling the units in with the air winch

end of this rod has a locking member similar to a toggle bolt. When the far end of the rod reaches the rear tube sheet, the locking member is turned 90 deg., thus preventing the withdrawal of the rod. The other end of the rod has a pulley. By removing this pulley from the rod the wire rope can run around the pulley groove and the hook secured to the unit for pulling it into place.

Checking Shaft Centers

The distance between the blower stub shaft and the cam shaft on General Motors Diesel engines, which must be kept within close tolerances, is easily and quickly checked by attaching an inside micrometer head to a rod which terminates in a V-block so designed as to fit snugly over the stub shaft.

The inside micrometer head is secured to the rod by a chuck. The rod is $\frac{1}{4}$ -in. diameter with the last $1\frac{5}{16}$ inches turned down to approximately $\frac{3}{16}$ -in. diameter to provide a snug fit in the chuck. The base is made from a steel block with the bottom portion veed out to slip over the blower stub shaft.



Checking the distance between the cam shaft and the blower stub shaft with a special micrometer gauge

Questions and Answers

The question and answer department is included for the benefit of those who may desire assistance on problems involving matters pertaining to the operation or maintenance of air brakes, Diesel-electric locomotives, steam locomotive boilers or steam locomotive practice. Any inquiry should bear the name and address of the writer, whose identity will not be disclosed unless special permission is given to do so. Anonymous communications will not be considered. Inquiries addressed to this publication will be referred to the source from which an authoritative answer can be secured.

Steam Locomotive Practice

By George M. Davies

Overfire Air Jets

Q.—We wish to apply overfire air jets to eliminate smoke on some of our six wheel switchers. Are there any special requirements for the location of the air jets?—M.E.R.

A.—The recommendations of Bituminous Coal Research, Inc., as covered by Technical Report No. VIII by Eugene D. Benton, for the location of the overfire air jets on switching locomotives are as follows:

Experience with various jet arrangements on locomotives engaged in switching or light transfer service has shown that steam-air jets for them should be provided with a 2-inch air tube. With an operating steam pressure of 150 lb. at the steam nozzle, the diameter of the nozzle should be $\frac{3}{32}$ in. when the burning rate is not in excess of 40 lb. per sq. ft. of grate per hour; or $\frac{1}{8}$ in. if the burning rate is between 40 and 60 lb. per sq. ft. per hour. It is not advisable to use a nozzle diameter larger than $\frac{1}{8}$ in. with a 2-inch air tube because of decrease in jet efficiency; hence, if the burning rate is in excess of 60 lb. per sq. ft. per hour, an air tube of larger diameter is required.

Jets should be placed on each side of the firebox according to the following rule: The first rear jet on one side should be located in the wrapper sheet at the fifth staybolt from the door sheet and at one staybolt above the level of the fire-door sill. The first jet on the opposite side should be located at the same height, but at the eighth staybolt from the door sheet. The other jets on both sides should be located six staybolt spaces (about 24 inches) apart, but at the height of the staybolt nearest to 16 inches, or four staybolt spaces, above the grate. The staggered arrangement as regards opposite sides results in maximum mixing of the volatile gases. Jets should not deviate more than one bolt spacing from that recommended, except for the one nearest the tube or throat sheet, which

may have to be lowered to void impingement on the syphon or arch tubes. If a branch pipe, or other gear, interferes enough to cause deviation from this rule, it should be relocated. Depending upon cab location, with reference to the back-head and grate line, the jet located at the fifth staybolt from the door sheet may fall within the cab. If it does, a hole must be cut in the floor to allow for placing the air intake of the muffler outside of the cab. The mufflers do not have to hang vertically, but may be given any angle to avoid interference with piping or brackets.

The object of locating the rear jets higher than the others is to allow a "heel" of coal to be carried in the back corners of the firebox without smothering jet action.

It is important that the toe of the arch be sealed. If it is not sealed, considerable quantities of smoke-forming gases can leave the firebox without benefit of the mixing effect of the overfire air.

Driving-Wheel Rims

Q.—What are the objections to driving wheels having cored rim pockets for the application of lead for counterbalance? Is not the lead more effective out in the rim than in holes located in the back of the counterbalance block, where the distance to the center of the wheel is reduced?—F.I.D.

A.—The rims of driving wheels should preferably be cast solid without cores, so as to obtain the maximum section and have full bearing for the tires. The cross-section through the rim in square inches should be at least 45 per cent of the sectional area of the tire when new. The use of cored openings in the rim of driving wheels for the application of lead for counterbalance has been discontinued on most railroads, the general practice being to use the solid rim.

Driving-Box Lubrication

Q.—In the conventional application of grease lubrication to the friction bearing driving boxes does the spring under the plate which carries the grease have to be strong enough to hold the grease to the journal?—M.E.K.

A.—The spring is used to hold the grease and the perforated plate in contact with the journal and should have sufficient tension to maintain this contact. However, the driving box lubrication does not depend upon the pressure of the follower plate spring to feed the grease to the journal box but rather on the speed of the journal passing over the perforated plate which draws it through the perforations.

Steam Locomotive Boilers

By George M. Davies

Staybolt Pitch

Q.—Does the diameter of a staybolt determine the staybolt pitch? For instance, on a boiler using one-inch staybolts could the pitch of the staybolts be increased when applying oversize staybolts of 1½-in. diameter?—R. E. D.

A.—The maximum pitch of the staybolts is determined by either of the following, using the minimum value obtained:

(1) Do not exceed a maximum stress of 7,500 lb. per sq. in. of net cross-section area on firebox and combustion chamber staybolts. In calculating this stress use the supported area less the area of stay at the root of thread multiplied by the maximum pressure for which the boiler is designed: divided by the net area of the stay. Net area means least cross-sectional area at any part, usually at root of thread less tell-tale hole, but may be at the center in case it is reduced below the bottom of the thread.

(2) The maximum pitch of staybolts based on the thickness of the firebox sheet, is obtained using the following A.S.M.E. formulae:

$$P = \frac{CT^2}{p^2}$$

Where:

P = Maximum allowable working pressure
lb. per sq. in.

C = 125 for plates 7/16 in. thick and under.

C = 135 for plates over 7/16 in. thick.

T = Thickness of plate, in sixteenths of an inch.

p = Maximum pitch, in inches.

The maximum pitch of the staybolts for a given boiler is determined not only by the strength of the staybolt, but also by the strength of the plate. Thus the pitch of the staybolts given in the question could be increased until the stress limit of 7,500 lb. per sq. in. on the 1½ dia. bolt was reached provided, however, the pitch did not exceed the maximum allowable pitch based on the strength of the plate.

Loads on Arch Tubes

Q.—How is the maximum load that can be carried on an arch tube determined?—R.E.S.

A.—The combined fibre stress (S) due to steam pressure and arch brick loading should not exceed 7,000 pounds per square inch, calculated by the following formula

$$S = \frac{PD}{2E} + \frac{AB^2}{2W} \left\{ 1 - \frac{B}{2L} \right\}^2$$

where

P = Steam pressure; lb. per sq. in.

D = Outside diameter of tubes; in.

E = Tube wall thickness; in.

A = Maximum weight of brick between two adjacent tubes, per 1 in. of arch length; lb

B = Length of arch; in.

W = Section modulus of tube; in. ³

L = Length of arch tubes between supports; in.

Tolerances in Shell Sections

Q.—When applying a new shell course to a riveted locomotive boiler, what tolerances are used for checking the out of roundness of the shell after rolling?—V.E.R.

A.—A good practice to follow would be the limits for distortion as stated in the Locomotive Boiler Code:—The barrel of the boiler shall be circular at any section within a limit of one (1) per cent of the mean diameter based on the difference between the

maximum and minimum mean diameters at any section, and if necessary to meet this requirement shall be reheated, rerolled, or reformed.

To determine the difference in diameters, measurements may be made on the inside or the outside, and when the barrel is made of plates of unequal thickness, the measurements shall be corrected for the plate thicknesses as they may apply, to determine the diameters at the middle line of the plate thickness.

Schedule 24-RL Locomotive Air Brakes

FIRST SERVICE POSITION

839-Q.—As the equalizing reservoir pressure is reduced on the face of the equalizing piston, what happens? **A.**—As in normal service position the higher brake pipe pressure moves the piston and unseats the discharge valve to allow brake pipe pressure to escape through the rotary valve to atmosphere.

840-Q.—What occurs if brake pipe pressure becomes slightly lower than equalizing reservoir pressure? **A.**—Piston 77 will move to the right and allow the short end of lever 79 to move upward out of contact with the equalizing discharge valve. Spring 83 will then cause the equalizing discharge valve to close, preventing further flow of brake pipe air.

841-Q.—What air pressure is connected to the maintaining valve in first service? **A.**—Feed valve air in chamber *A* above the rotary valve is connected through the rotary valve, passage 14, cock 42 and passage 14a to the maintaining valve.

842-Q.—How does the maintaining valve function? **A.**—If for any reason, brake pipe pressure reduces at a faster rate than the controlled rate of equalizing reservoir pressure reduction imposed in first service position, brake pipe pressure, acting on the right side of the piston, will be less than equalizing reservoir pressure on the other side. This will cause the piston to move to the right, lever 79 will contact with the maintaining valve and move it from its seat, allowing feed valve air from passage 14a to flow into chamber *N*, thence through passage 2b to the brake pipe.

843-Q.—What is the result of this action? **A.**—Prevents brake pipe from reducing faster than equalizing reservoir, causing a slower brake pipe reduction throughout the train, accomplishing thereby a more uniform control of the braking force and minimizing slack action.

844-Q.—Can first service position be cut out? **A.**—Yes. By turning cock 42 to Out position, which closes seat passages 14a and 24, leading to the maintaining valve and reduction limiting reservoir. First service position may then be used as lap position.

EMERGENCY POSITION

845-Q.—What is the first movement in this position? **A.**—When the handle of the automatic brake valve is moved to emergency position, the emergency valve

plunger 240 unseats emergency pilot valve 243 which permits emergency valve 241 to unseat quickly and provide a large direct passage from the brake pipe and port 1 to the exhaust, so that an emergency rate of brake pipe reduction is obtained.

846-Q.—How does the equalizing portion of the brake valve respond to this movement? **A.**—The reduction of brake pipe pressure in chamber *N* permits the higher equalizing reservoir pressure to move the piston to the extreme right.

847-Q.—What results from this action? **A.**—The by-pass port in the piston bushing is uncovered, connecting chamber *D* to chamber *N*. Equalizing reservoir pressure then flows from chamber *D* to chamber *N*, through passages 2b and 2 to brake pipe passage 1, which connects to the atmosphere through emergency valve 241 as described above.

848-Q.—Describe the operation when a service application portion is used. **A.**—The brake pipe cut-off valve 151 is balanced in the emergency position of the brake valve by venting the air from both ends of the cut-off piston. Air from below cut-off piston 146 flows through passage 2a and port *t* in the application slide valve 114 to join the air from the top of cut-off valve in passage 2 thence through the rotary valve and exhaust passage to the atmosphere.

849-Q.—What results from these connections? **A.**—Spring 155 holds the cut-off valve unseated which will permit recharging the brake pipe as soon as the brake valve handle is moved to release or running position.

Diesel Locomotives*

Speed-Load Control

Q.—What is the reaction of a governor with too little oil?

A.—The governor will continue to operate as long as there is enough oil to move the power piston. When the oil becomes aerated to too great an extent, the governor fails to operate and the engine dies.

Q.—If speed is changed, does the pilot valve have to be reset?

A.—Resetting the pilot valve is not a necessity, but always good practice. If in changing the speed a change is made on the location of the speed-setting piston or the change at idle, it becomes a must.

Q.—What effect has counter electromotive force on the operation of locomotive?

A.—While the traction motors are running as a motor they also work as a generator, as they are generating counter electromotive force and are forcing back at the main generator while the main generator is forcing voltage or pressure towards them. When the point is reached where we start to unload the engine, the load regulator moves to increase the magnetic strength of the field, building up a higher

* These questions and answers were submitted following a talk at the July meeting of the Chicago Railroad Diesel Club by M. Sudheimer, Electro-Motive Division, General Motors Corporation on speed and load control of E.M.D. locomotives.

voltage in the main generator. Actually, the counter e.m.f. of a traction motor when traveling at high speed with the throttle in the 8th position where main generator voltage may reach 950 or 980 volts, the counter e.m.f. may be as high as 920 or 950 volts, or within about 30 volts of the voltage out of the main generator. That is the part that the counter e.m.f. plays in locomotive operation.

Q.—Would it be correct to say counter e.m.f. is resistance? Does it change with speed?

A.—Since counter e.m.f. is voltage trying to move current in the opposite direction from that of the main generator, we can say it is resistance. If the throttle is left unchanged, back e.m.f. will change with speed but speed alone does not necessarily mean a change in back e.m.f.

Q.—Explain the importance of the vane motor at the pilot valve balance point.

A.—The vane motor may be in any position when the pilot valve reaches balance. As long as the pilot valve is at balance and we bring that load regulator vane motor to a standstill, we have reached the balance point, and depending upon the condition of the engine when balanced under load, the load regulators may be in any position.

Q.—What action takes place when the governor is overloaded with oil?

A.—There is a continuous hunting of the governor because the flyball weights fight their way through oil moving outward to where they overrun as far as speed is concerned. In fighting their way back through the oil, once more they overrun in the opposite direction. Because oil is being churned up by the flyball weights in the F3 governor (the electro-hydraulic governor) there is a lot of suds from the gears chewing up the oil.

Q.—How is the pilot valve balanced?

A.—By moving it to get action on the vane motor of the load regulator. Moving the vane motor somewhere so that it is out of the extreme minimum or extreme maximum field, then adjusting the pilot valve until the load regulating vane motor comes to a standstill, gives the exact balance point on a pilot valve.

Q.—What would you do on a quick turn-around on an F3 unit when the engineman reports the engine not loading properly? Also explain modified maximum field start.

A.—Adjustment on the pilot valve can be made if there is time on a turn-around. If you have 30 to 45 minutes, check the adjustment on the pilot valve, but an engine not loading can be just as easily caused by the electrical system. It could easily be a fuse blown, so make a sequence test to insure you that it is not in the electrical system.

Modified maximum field start is a setting put on the pilot valve. The adjustment sets the pilot valve below the balance point, where we actually get a reading of maximum field start, but on the F3 governor (the electro-hydraulic), the overriding solenoid will hold the load regulator in minimum field during the time that the throttle is in idle. As soon as the engineman advances the throttle one notch the overriding solenoid is de-energized allowing the pilot valve to

drop below the balance point, because it is spring loaded and the load regulator will start traveling towards maximum field, which will give a smooth start 10 to 12 seconds faster.

Q.—On an F3 locomotive, what causes the ground relay to pick up when the throttle is moved to idle after the engine has been loaded if the ground relay is O.K. under load, and nothing is found wrong with the electrical equipment or the circuits.

A.—The commonest cause of the ground relay tripping when going to idle is in the engineman moving the throttle to idle too fast thus pulling the power contactors apart under a heavy load causing a heavy enough arc or amperage break to strike the doors of the electrical cabinet and cause the ground protective relay action.

Q.—What is the relationship of the load regulator adjustment and piston ring breakage?

A.—There is no relationship between load regulator adjustment and piston ring breakage. An improperly adjusted pilot valve will give an overloaded engine. However, this does not indicate relationship to ring breakage, because ring breakage seems to be tied more closely to the quality of fuel than the quantity which would be the case with an overloaded engine. Generally it is in the quality of fuel, not the quantity, nor in the adjustment of the load regulator or pilot valve.

Q.—Is it possible that cracked cylinder heads and leaking cylinder liner gaskets may be caused by an improperly adjusted load regulator?

A.—If this question is interpreted to mean pilot valve adjustment instead of load regulator adjustment then there is some correlation between the two since an improperly adjusted pilot valve can overload an engine till the engine that normally puts out 1,500 hp. may be putting out 1,750 or 1,800 hp. In such case the overloaded engine has leaking liner gaskets, cylinder head to liner gaskets, and possibly cracked heads. There is no relationship between cracked heads and leaking cylinder liner gaskets and an improperly adjusted load regulator.

Q.—What causes a governor to fail to carry the engine speed, but after working with the engine for about a half hour the engine is O.K. and will make a trip but next time it is shut down it repeats.

A.—Probably due to dirty ball checks in the governor due to the fact that oil is pumped back into the sump of the governor rather than onto the accumulator.

Q.—What would be the cause of a Model 567 engine shutting down when the throttle is closed from 5th, 6th, 7th or 8th notch; the governor tries to recover and hold running speed but doesn't quite hold the speed?

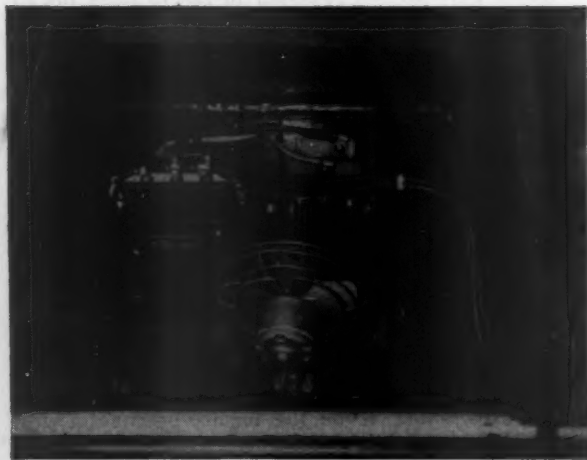
A.—It is a problem of improper adjustment of engine speeds. That would vary in the actual setting depending on whether it is the electro-hydraulic governor or whether it be the electro-pneumatic governor. It is a problem of incorrect setting of engine speeds where engine speed actually is low, both at idle and top speed, and probably all the way up and down the line.

ELECTRICAL SECTION



Boston and Maine caboose C-29 equipped with 12-volt train communication power supply

Twelve-Volt Caboose Power



The regulator and the rectifier with its cooling fan are mounted on a board 16 in. square

Boston & Maine develops inexpensive equipment which now has a 10,000-mile performance record

SPACE-RADIO communication is being used on Boston & Maine freight trains between Boston, Mass., and Mechanicville, N. Y., a distance of 187 miles, and between Mechanicville, N. Y. and Portland, Me., a distance of 270 miles. The radio equipment, supplied by the General Railway Signal Company, employs a frequency of 159.93 mc. for end-to-end communication and 159.69 mc. for train-to-wayside. There are three wayside stations,—one with its antenna on the roof of the Boston & Maine general office building, in Boston, Mass., one at Greenfield, Mass., and one at Mechanicville, N. Y.

The small size alternator shown here weighs only 30 lb.



Trains are able to communicate with the Mechanicville station for a distance of about 15 miles, and the Greenfield station also has a range in each direction of approximately 15 miles. From Boston, contact can be maintained with the train for nearly 30 miles because of the height of the Boston antenna.

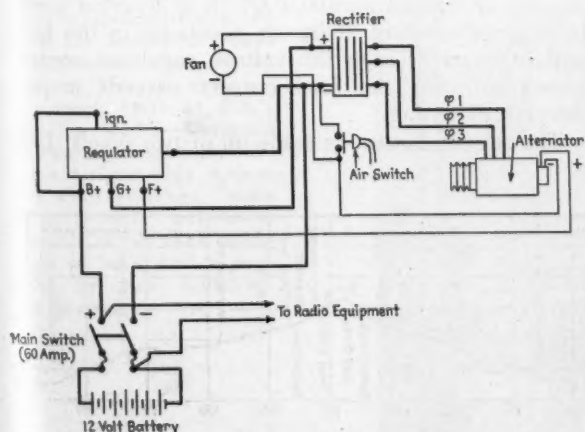
All sending and receiving sets for both wayside and mobile stations are identical and operate from 117-volt, 60-cycle, a.c. power. At wayside stations, this is obtained from power lines, and on Diesel locomotives the d.c. power from the control batteries is converted to 117-volt a.c. by a rotating converter. This method of conversion is also used on a caboose equipped with a 32-volt d.c. source of power.

A second caboose, the C-29, has a 12-volt power supply system. It is an experimental installation, de-

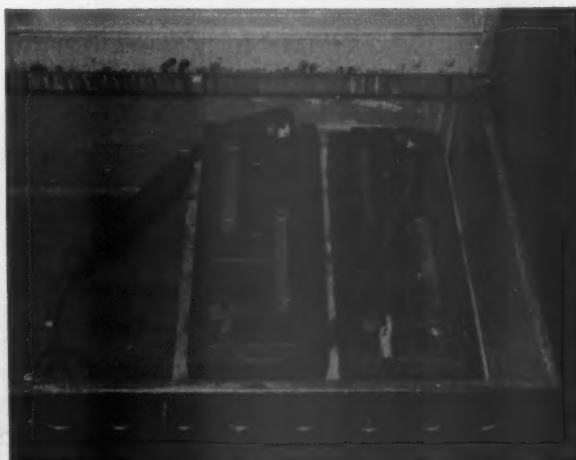
signed to test the practicability of low-voltage battery charging equipment for caboose radio power.

The axle-driven generator which supplies the power is a 14-volt alternator, suspended from a bracket riveted to the caboose underframe. It is driven by three endless vee belts which run from the generator pulley, over an idler above the axle to a second idler behind the axle, and back over the axle pulley to the generator.

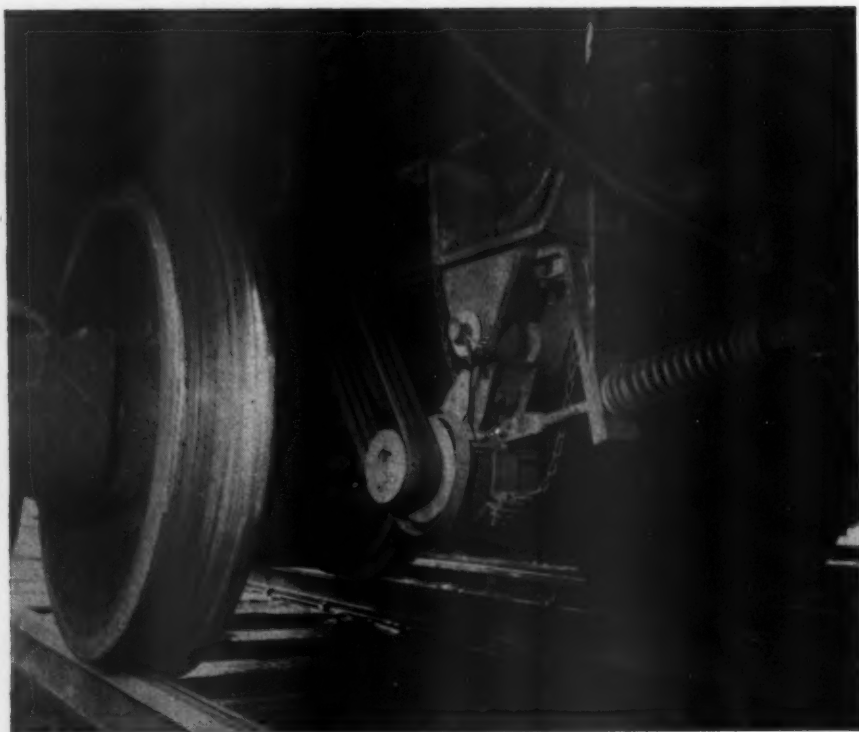
The suspension, which is shown in one of the illustrations, is similar in design to those used in mounting generators used for passenger car lighting.



Wiring diagram for the 12-volt caboose power system



The batteries which are under a seat are braced with wooden cross pieces secured to the end of the seat box by threaded steel rods



Axle power equipment under the caboose

The end of the belt tension rod is threaded, and tension may be adjusted by means of the tension nut and lock nut on the end of the rod.

The generator pulley has a 4-in. pitch diameter. The idler pulleys have 6-in. pitch diameters and are mounted on brackets riveted to the caboose center sill. They are so located that the backs of the three vee belts contact approximately 90 deg. of circumference of the 20-in. diameter flat face axle-mounted pulley.

The pulley sizes are such that the generator starts to deliver power at 13 m.p.h. Full generator output is available at a speed of about 20 m.p.h.

The all-steel caboose has a Duryea underframe which greatly reduces coupling shocks that would otherwise be transmitted to the caboose and no trouble has been experienced from broken belts.

The system employs a Leece-Neville, 14-volt, 60-amp., three-phase variable frequency alternator, a full-wave selenium rectifier, a voltage and current regulator, a 12-volt fan for cooling the rectifier plates, a 12-volt, 150-amp.-hr. lead-acid battery and necessary switches and fuses.

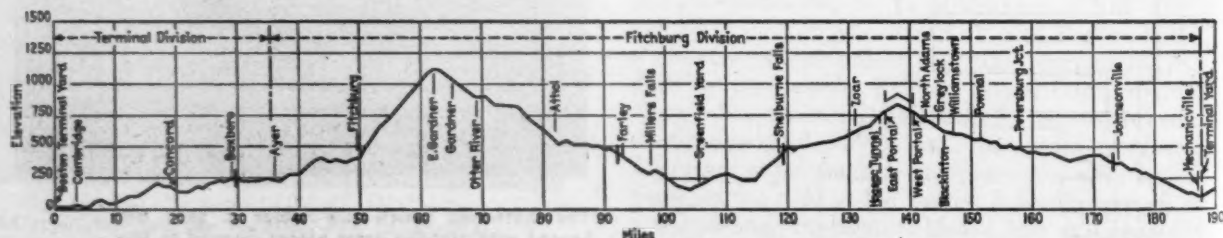
The field of the alternator rotates, and field ex-

citation is obtained through two small slip rings and suitable brushes which are connected to the battery through the control equipment.

The frequency of the alternator is one-tenth its speed in r.p.m. Thus, at 500 r.p.m., the frequency is 50 cycles per second. Field polarity or direction of rotation does not affect the polarity of the d.c. output. Therefore, no commutator or pole changer is required and since current does not flow backward through the rectifier, there is no need for a reverse current relay.

The a.c. output of the alternator is rectified by an air-cooled, three-phase, full-wave bridge type selenium, dry-plate rectifier. Regulation of the d.c. output from the rectifier is accomplished by a voltage regulator controlling the amount of resistance inserted in series with the rotor field coil. Current regulation is obtained by the use of a load limiter element or current regulator which is actuated solely by a series winding. It inserts resistance in the field circuit in addition to the voltage regulator control resistance when the load current exceeds a predetermined setting.

The storage battery is made up of two 6-volt, 150-



Profile of the Boston and Maine line over which the train communication is being operated



General arrangement of apparatus in the caboose—The battery is shown in the lower right-hand corner, the rectifier and regulator in the next compartment under one of the seats, the radio set with cover removed, and behind it on the wall is the main switch

amp.-hr., Exide type 3-LXWG-21R trays connected in series. Full charge specific gravity is 1.260 to 1.285.

The main switch connects the battery to the radio

power unit and also connects the battery to the axle power unit. It is turned off when radio communication is not required, to avoid unnecessary battery discharge.

From the wiring diagram, it may be seen that the circuit also includes what is marked "air switch." This switch is closed by brake pipe air pressure when the pressure is above 30 lb., and opened when it is less. This prevents current consumption through the rectifier cooling fan and through the alternator field when the caboose is standing in the yard. The pressure of 30 lb. was selected to avoid operation of the switch due to brake line pressure reductions caused by brake applications. Regardless of brake pipe pressure, radio is available for use at all times while main switch is "ON".

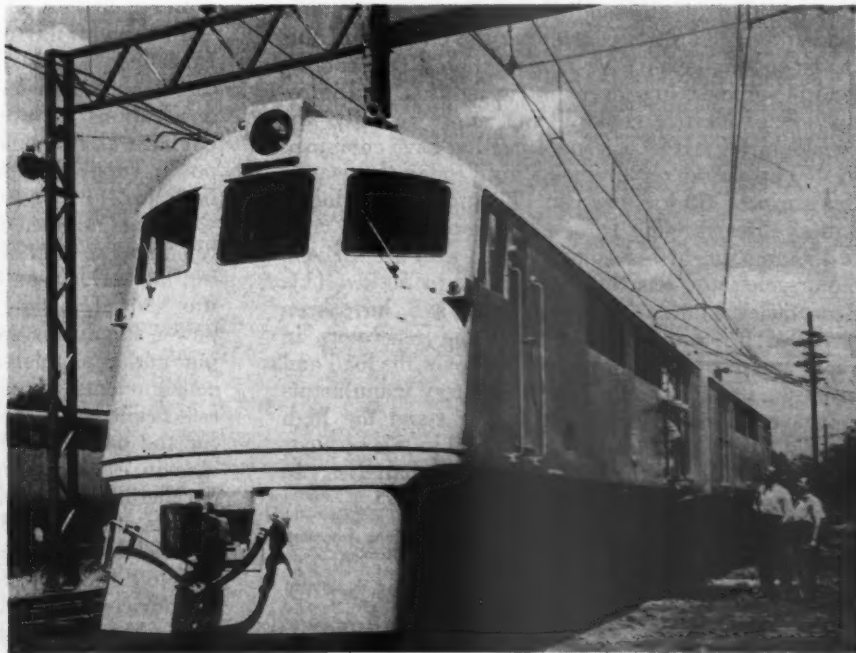
Power Unit

The power unit in the radio set produces the required 117-volt power by means of a vibrating type inverter and a transformer. Standby power consumption is about 100 watts while transmitting power consumption is 300 watts.

Except for one or two cases when the main switch was left in the closed position when the caboose was out of service, the generator has kept the battery charged. The margin of power, however, is small, and if this type of equipment is applied to other cabooses, it is probable that a 100-amp., rather than a 60-amp., generator will be used.

The equipment was installed under the direction of R. I. Kendall, assistant supervisor of air brakes and train control, Boston & Maine, with the cooperation of the Leece-Neville Company, Cleveland, Ohio, and the Dayton Rubber Manufacturing Company, Dayton, Ohio. It was installed by railroad forces at their Concord, N. H. shops.

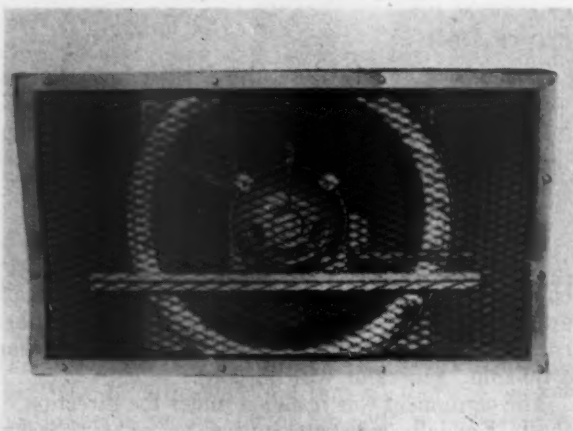
First of 35 new Diesel-electric locomotives being built for Argentina's General Belgrano Railways by General Electric undergoing track tests at G.E.'s Erie, Pa., works—Designed to haul passengers and express freight over Argentina's meter-gauge "main lines," each locomotive consists of two cabs joined back to back and is powered by two 1,000-hp. Diesel engines



Under-Car Engine-Driven Power Plants*

Early standardization will avoid unnecessary and expensive redesigning of equipment

By D. R. MacLeod†



Engine cooling radiator unit showing fan

THE battery and axle-driven generator power supply system has been standard on passenger cars in this country since the introduction of electric lighting. The addition of air conditioning 20 years ago was made possible only by extending the capacity of this inefficient and expensive combination. The cooling load in summer, improvements in lighting, and introduction of electric cooking and, more recently, the consideration of electric space heating have combined to step up power requirements until today they sometimes exceed 50 kw. per car. To supply such loads, battery sizes ranging from 1200 amp.-hr. at 32 volts to 450 amp.-hr. at 114 volts are used with axle-driven, motor-generator sets that put out 40 to 50 kw. (1). Receptacles with capacities up to 35 kva. have been provided for a.c. power to drive the generators in yards and terminals in order to take over the load and bring the batteries up to charge. Battery manufacturers have improved their product to stand the high rates of charge and discharge common in this service; but even now railroad passenger-car batteries, in many cases have a life of only three years.

* Abstract of a paper presented at the Fall Meeting of the American Society of Mechanical Engineers held in Erie, Pa., September 27-30, 1949.

† Railroad Rolling Stock Division, Locomotive and Car Equipment Divisions, General Electric Company, Erie, Pa.

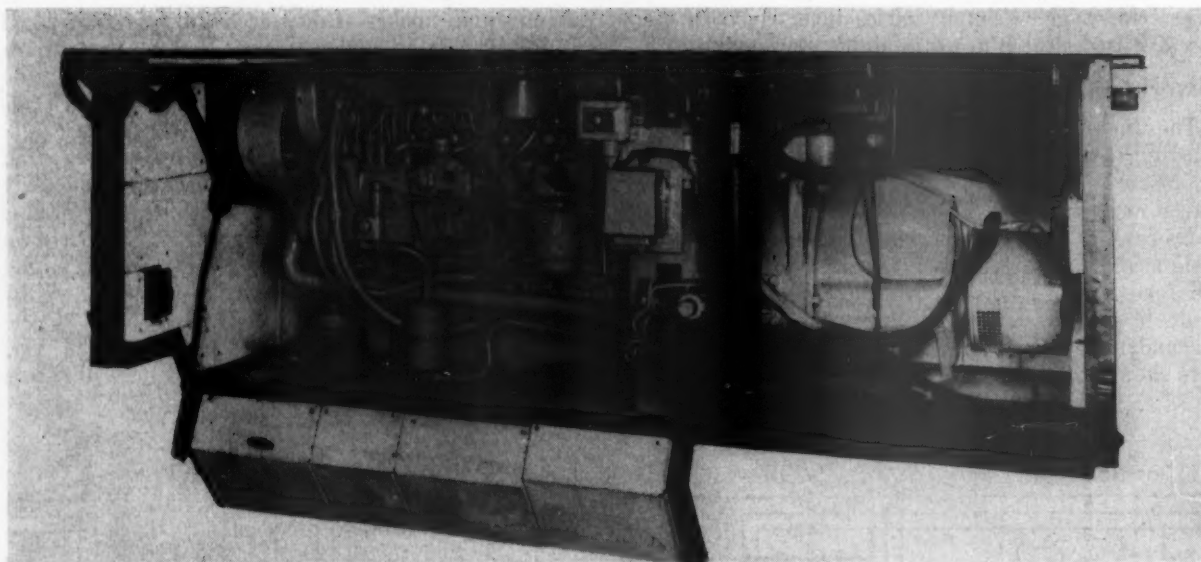
Note: The figures, 1 to 14, appearing in the text are references to the bibliography at the end of the article.

The axle-driven generator requires approximately two engine horsepower from the locomotive for every kilowatt it generates. The portion of the locomotive capacity used in this way costs and weighs approximately five times as much as the generator itself. The total weight of the power supply equipment on a modern coach and its portion of locomotive weight is approximately 20,000 lb. The cost of maintaining this portion of the locomotive is several times that of the axle generator. Maintenance costs of batteries differ widely.

About 15 years ago, General Electric began to seek methods of improving this situation. Head-and power, (2) in which Diesel-engine-driven alternators in a power car supplied power to the entire train by means of power lines, was considered. One installation made over ten years ago is still in operation. Recently this plan has again been studied (3) (4). It has the basic limitations that all cars must be wired for the system and that, when the train is separated for any reason, power is lost on all cars beyond the break.

In the late thirties installations were made, on an experimental basis, of Diesel-engine-driven alternators mounted under the car (5), but no large scale applications followed. At that time the small Diesel engine was not sufficiently reliable for passenger-car power supply unless backed up by large expensive batteries.

A large number of Diesel-engine-driven alternators rated at less than 50 kw. performed successfully during the war. Near the close of hostilities a program was started for the development of an independent power supply for passenger cars. This included testing under simulated service conditions, and later, consignments of experimental equipments to interested railroads. A practical system has been devised for the parallel operation of the sets on individual cars in a train. This includes a simple scheme of paralleling by making or breaking the electric coupler sockets at the time the cars are coupled or uncoupled. No special knowledge is required of the "car-knockers" to do this work, and no complicated synchronizing devices are used. By proper consideration of all the engineering problems, an alternator-exciter-regu-



Power plant in position in box for under-car mounting

lator system was devised which permitted the simplest form of control. Servicing of the equipment was given special consideration in the mechanical design (1). A heat recovery system has also been formulated and reduced to practice by at least one of the car-heating companies.

Certain basic engineering factors must be considered in the design of an engine-driven, under-car alternator. Railroad engineers should understand these so that some measure of standardization can be worked out by the Association of American Railroads. It is only by early standardization that the railroads will obtain maximum flexibility in operation and low costs.

Clearance Requirements

The size of the power plant that can be installed under a car is determined very largely by the equipment clearance line permitted by the railroads; to allow margins of safety from known obstructions, and to allow for wear and movement of parts in rounding curves. The height of the obstacle, plus the margin of safety allowed for clearance, plus the allowance for vertical wear and car movement give the total height that the bottom of any equipment on the car must be kept above the top of the rail when the car is new. Similar allowance must be made for worn flange play, journal-box play in the pedestal, movement of the center plate and movement of the swing bolster in a swing-bolster truck. To this must be added the offset of the car, at the point where the equipment is mounted, when it is on the curve where the worst lateral interference is found.

In the clearance diagram *KABCDE* shows the equipment line which is a composite of the requirements of a number of railroads, with the equipment mounted at a selected point between the truck centers. This is not a standard equipment line, and is included only to illustrate the problem. This line was established for a point that had a total lateral movement of

14 $\frac{5}{8}$ in. from the center line of the track and a total vertical movement of 5 in. due to wear and clearance requirements. The line *ABCDE* moves upward for greater allowances for wear, margin over obstacles, etc. The line *BCD* moves to the right for sharper curvature, more allowance for lateral movement, and for mounting closer to the transverse center of the car.

The height of the center and side sills, and the width of the cars built since World War II vary considerably. In numerous cases the bottom of the center sill is only 24 in. above the rail. Line *KLMNOP* was made up as a composite of all these cars, taking the limiting dimensions in each case. The result of this study indicates that the over-all height of under-car equipment located at the outside of the car cannot exceed 26 $\frac{3}{8}$ in. More vertical space is available toward the center line of the car. In the older cars the center sills are higher above the rail, but there is less room between the center sills and the car sides. Thus, on postwar cars, the over-all depth of the equipment at the level of the center sill may be 47 in., but on many prewar cars it is slightly less.

The over-all length of any single piece of equipment is limited by the location of needle beams and, on roomette cars, the location of hoppers, etc.

Selection of Engine

There are very few engines now on the market, of a size suitable for vertical mounting under the car, that can be rated at 50-50 hp. continuous output for railroad application. A few horizontal engines suitable for this purpose have been developed. The relative advantages of the two types can be evaluated only by experience with a large number of units. A displacement of 250-300 cu. in. is required in an 1,800-r.p.m. engine for an output of approximately 30 kw. in railroad service, if the four-stroke cycle is used. With a two-cycle engine a smaller displacement may be used. Since the volume of the engine-genera-

tor set for a given output varies inversely with the speed, it is desirable to use a high-speed engine.

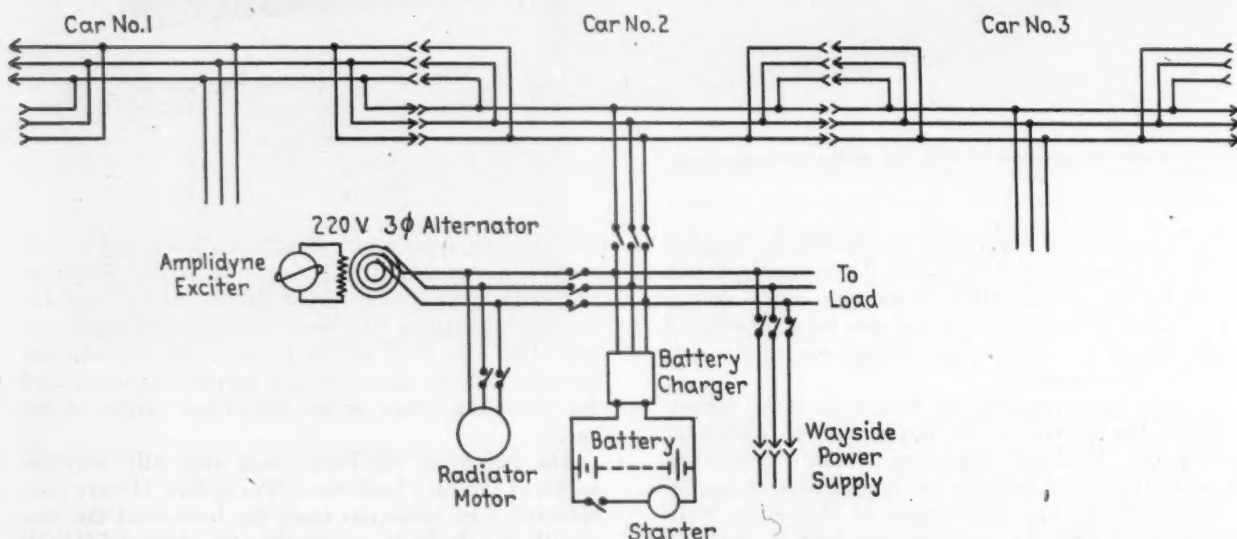
Governors

The fuel-pump, injector and governor assembly constitute a large part of the small Diesel engine cost. To insure a fair division of load between engine-driven alternators operating in parallel, speed droop is desirable. The average mechanical governor (6) is designed for about 3 per cent droop from no load to full load. This is insufficient for under-car power plants because variations in setting are bound to occur under railroad maintenance conditions. Governors should be set as close together as possible at no

seven square inches of duct area will be required. If it is taken from under the car, some form of air cleaner should be provided to supplement the conventional oil-bath filter, as the air will contain large amounts of dirt and brake-shoe dust.

The exhaust back pressure should not exceed about 3 in. of mercury. The muffler requires approximately 1.3 in., leaving some 1.7 in. for the piping. This is important when the exhaust gases are carried up through the roof of the car. Stainless steel tubing should be used because of the corrosive action of the exhaust.

This is a problem in vibration engineering (7). Engine-air intakes in the car will cause noise that it is



Wiring diagram for under-car power plants

load—a speed equivalent to 62 cycles is suggested as standard for the A.A.R., as this is the upper limit of frequency variation for standard power consuming devices. If no load conditions exist on an entire train, which is improbable, some power exchange is to be expected unless preventive control is provided. Experience will show whether this control is necessary.

Governor damping is necessary to prevent hunting. Its form will differ with the type of governor used. This supplements the electrical damping provided by the alternator to maintain over-all system stability.

Temperature Control

Factory tests indicate that an engine-alternator set should not carry more than about half load until it is warmed up to approximately 50 deg. F. The temperature differential from inlet to outlet jacket water should be held to about 10 deg. F. under continuous operating conditions. The engine should be shut down if the jacket water approaches the boiling point.

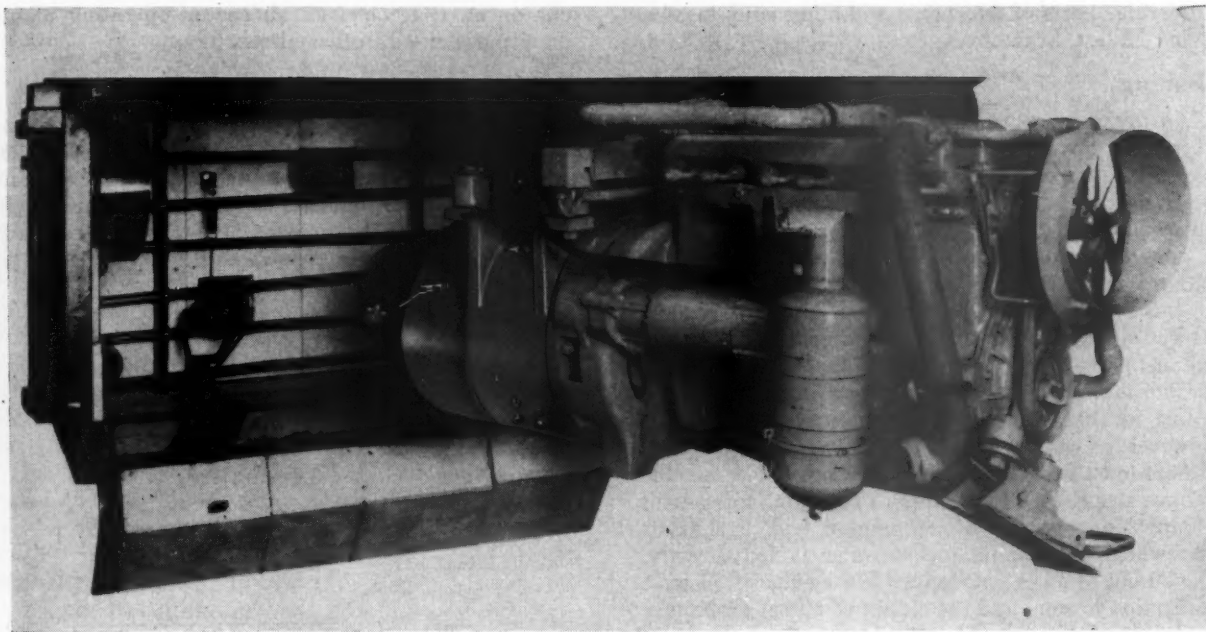
Engine Air and Exhaust

Engine air should be as clean as practical. If it is taken from the interior of the car, approximately

difficult to reduce below the threshold normal ambient noise with the car at rest. When exhaust is carried up through the car body, ducts must be designed to reduce noise to a minimum (8). The principal source of noise is vibration transmitted from the engine to the car body. The set must be isolated from the car by rubber-in-shear (9) designed for the low-frequency pulsations of an engine. A set in one location may cause more noise inside the car than it would in another location. Roomette cars present a special problem due to the openings into the car in the vicinity of the engine. Modern coach construction effectively isolates air-borne noise.

Fuel Tank

Fuel tank capacity will depend on the interval between fuelings. Assuming a 50 per cent load factor, the engine will consume approximately 2 gal. per hr. Sufficient fuel should be provided to insure against its exhaustion; otherwise the fuel pump has to be primed before the engine can be restarted, and some fouling of the injectors will occur. An alternator in a paralleled group will operate as a synchronous motor when the fuel of its engine is exhausted. A small engine



Power plant swung out of box for inspection and replacement

may consume as much as one gallon of fuel per hour at light load. Continuous engine operation at no load will result in fouling of the fuel injectors. "False-Brinelling" (10) of the bearings may occur if the alternator does not rotate for long periods while the car is in motion. Experience will indicate which is the more serious consideration.

Battery Capacity

Approximately 500 amp. at about 20 volts is required to start the set at temperatures in the neighborhood of zero. Approximately 350 amp. at 22 volts is required at 32 deg. F. This indicates a 150-amp.-hr., 16-cell lead battery, or a higher amp.-hr. rated nickel-iron-alkali battery.

Excitation System

Successful car-lighting equipment must preclude objectionable flicker of the lights. Fluorescent lamps are not as much affected by sudden dips as are incandescent lamps, particularly if the voltage and frequency vary together. Dips of more than 15 per cent below minimum rated lamp voltage may cause starter-equipped fluorescent lamps that have just been switched on to go out. Larger dips of short duration can be tolerated if the lamps are warm. This problem is not as severe with instant-start ballasts. Time is a very important factor. If the flicker recurs every few seconds, only a fraction of a per cent voltage variation can be tolerated. Such variations are liable to occur on incandescent lamps due to engine pulsations. Mechanical and electrical characteristics of the alternator must be such as to prevent objectionable dips in voltage when large induction motors are started across the line or two 30-kw. alternators are paralleled when 180 deg. out of phase.

These requirements necessitate an ultra-high speed excitation system. The development of the amplidyne

made it practical to get the precise control necessary for such a system.

The amplidyne (11) has an exceedingly short time delay. These characteristics make it ideally suited for engine-driven alternators. It requires only about one watt to control its entire output and, therefore, uses a static regulator of small dimensions.

Alternator

The dimensions of under-car alternators are determined by excitation requirements rather than by heating. With a vertical engine, the diameter of the alternator may become the limiting dimension in a power plant. Therefore, a small-diameter alternator is an advantage, if it can be obtained without sacrificing desirable electrical characteristics. The alternator, when operating alone, must be able to start a 15-hp. air-conditioning compressor motor without objectionable flicker of the lights.

Parallel operation requires the addition of a pole-face winding to the alternator field. This serves to reduce hunting and maintain stable operation. It also provides additional torque for pulling the machine up to speed when the alternator is paralleled out of phase and below synchronous speed. Its principal disadvantage (aside from cost) is that the short circuit currents of the alternator are increased. Hence, it is desirable to use the minimum amount of pole-face. (amortisseur) winding required to give successful parallel operation.

Mechanical construction is very important. Armature windings must be braced to withstand the forces produced by the high currents that sometimes occur during synchronizing. All windings must be treated with several coats of water- and dirt-resistant varnish. The same general practice should be used for the construction of these alternators as is used for axle-driven generators. Care must be taken to avoid exposure of

vulnerable parts of the engine and other equipment to flying ballast, brakeshoes, etc.

Heating

An under-car power plant provides a good source of heat for hot water and space heat. The average car requires approximately 170,000 B.t.u. per hr. for space heating. For hot water, passenger cars require up to 50,000 B.t.u. per hr., and diners up to 80,000. A good upper figure is 250,000 B.t.u. per hr., and in extreme climates, 350,000. A 30-kw. engine alternator has available the heat equivalent of approximately 90 kw. divided about equally between jacket water, exhaust gases, and electrical output. This is sufficient for the majority of cars, while still leaving enough power for lights, ventilating fans and refrigeration. However, in case of engine failure, some other source of heat must be made available. Since it is desirable to have steam heat for standby operation, an efficient combination consists of a common heat exchanger into which the engine jacket water is fed directly. The output of a heat exchanger in the exhaust, electric immersion heaters and the output of a heat exchanger in the steam line provide the remainder of the heat. Since the engine jacket water temperature is held at 180 deg. F., this leads to a 180-deg. F. heating system. Such a system permits the locomotive train-heating boilers to be shut down during most of the year.

Engine Pulsations

Engine alternator design must consider the power pulsations that can occur in parallel operation. The torque of an engine will have pulsations above and below the average due to the firing of the cylinders (12). Resonance occurs when the torque that is making the alternator swing is in step with the natural frequency of the alternator and prime mover. In a properly balanced engine, the torque pulsation frequency will be the same as the r.p.m. for a two-cycle engine and equal to half the r.p.m. for a four-cycle engine. Harmonics of the fundamental will also be present in the torque pulsation. Any unbalance between cylinders such as that caused by fouled injectors, will increase the magnitude of the pulsations. Reasonable allowance for this must be made in the design.

In the usual case it is sufficient to determine the natural period of each of the engine-driven alternators acting alone, and to make sure that the frequencies of the disturbing forces fall outside the band given by the highest and lowest frequency.

Negative Damping

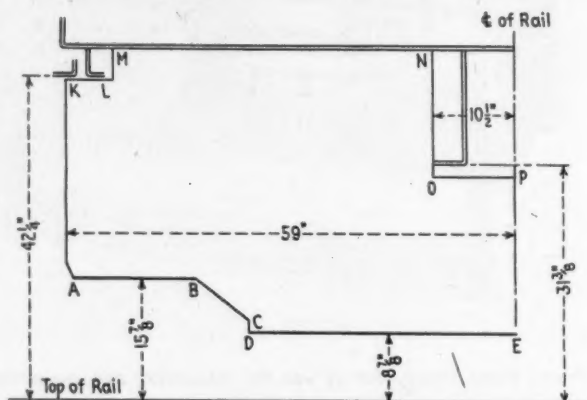
There is a critical limiting value of resistance in the armature circuit of an alternator of the type used in the under-car power plant beyond which cumulative hunting may occur. When this occurs at no load, it can usually be stopped by additional amortisseur effect. The severity of hunting increases as the excitation is increased. An adverse regulator characteristic may, therefore, contribute to the severity of this phenomena under certain conditions.

High values of alternating torque are developed on sudden short circuit (13). These short-circuit torques are experienced when single-phase short circuits oc-

cur on an engine-driven alternator operating alone, or in parallel with other alternators.

Synchronizing

In stationary power plants, the frequency of an incoming alternator is brought very close to that of the bus and the line switch is closed when the two voltages are nearly in phase. Equipments are available for automatic synchronizing. They are not necessary with under-car power plants, and their use is to be



Equipment line for postwar cars with 14 3/4 in. total offset from centerline of track due to maximum curvature plus lateral movement (new car)

avoided because they represent additional control devices to maintain. It is necessary, therefore, to design for the transient torques generated when the incoming machine is paralleled when out of phase with, and differing in speed from the bus.

When a single alternator is paralleled on a hit-or-miss basis, the electrical transient torques may be worse than the short-circuit torques previously described. They are usually not appreciable if the speeds are relatively close and the electrical angle between the incoming machine and the bus is on the order of 30 deg. or less. The lower the reactance of the alternator, the smaller the angle at which the electrical torques become appreciable.

Tests on small under-car power plants show that the minimum over-all disturbance is obtained when paralleling by applying the field before closing the line contactor. The disturbance is violent if the paralleling occurs when the incoming machine is 180 deg. out of phase, but of much shorter duration when the paralleling is done with the field fully excited than when it is done with the machine unexcited. It has also been found that with proper design it is practical to parallel a machine with the bus when its speed is as much as 10 per cent slow.

It is recognized that critical speeds may exist at speeds below normal, and that the engine has to go through these criticals in coming up to speed (14). Generally this is not serious because the set will pass through the critical speed before the vibrations have time to build up. Out-of-step operation is not likely to occur under normal conditions because the reactance between machines is relatively low and because the fuel limit on the governor tends to unload an overloaded generator. It is of course possible for the

paralleled group of alternators to become overloaded and fall below rated speed.

Load Division

If two alternators are paralleled, their characteristics are such that any small difference in voltage will be equalized by the flow of leading or lagging current. These currents have a cumulative effect and will build up to large values unless precautions are taken to prevent it by "cross-compensating" the voltage regulators. A resistance is inserted in the connection of the potential coil of the regulator to the two-phase wires. A current transformer in the third-phase wire is connected across the resistor so that zero power factor lagging or leading current adds directly to or subtracts directly from the phase voltage. This "fools" the regulator into believing that the voltage is high or low as the case may be and it adjusts the excitation accordingly. The connection of the current transformer across the resistance is such that increasing the resistance causes the current to come more nearly into phase with the voltage. This compensates for inequalities in the regulator settings and for the pulsations in voltage due to engine operation, and divides the reactive load equitably between the machines. Changing the voltage of one machine in a group operating in parallel can only change the division of the reactive current. The division of real power is determined by the engine governors. These are selected to give a drooping characteristic so that the speed falls as the load increases. A 5 to 6 per cent droop is desirable to secure a reasonable division of real power unless excessive speed control devices are used. Attempts should be made to set the no-load speed of all governors the same and depend on the slope of the characteristic to keep the division of load reasonably close when the individual slopes are different.

The droop in the governor and the biasing of the regulator (cross compensation) introduce voltage and frequency variations which are not necessary when the engine-driven alternator operates alone. Commercial induction motors are guaranteed for a ± 5 per cent variation in frequency and a ± 5 per cent variation in voltage, or a total of ± 10 per cent variation in both frequency and voltage combined. Similar variations are permissible in other devices, but care should be taken that the resultant voltage limits are suitable for all devices.

A number of different schemes are available for securing automatic paralleling of alternators in the train when cars are cut in or out. In general, the greater the number of control wires used, the less complicated the scheme becomes. It is possible to use only two wires. A great step in simplification can be made if three wires are used, and further simplification is possible with more wires. The basic requirements are that, when one group of cars is coupled to another, one of the groups is broken up into single, or at the most two, alternator units in such a way that power is left available on each car. The units are paralleled one at a time to keep the rush of current through the contactors to a minimum. The control wires should be in the same receptacle as the power terminals so that when the power circuits are to be separated at

the receptacle suitable line contactors remove power before the circuit is broken at the power plug.

Dummy receptacles must be provided for the plugs that are not coupled to another car, and these can be used to form terminating circuits indicating the two ends of the train. Eventually some system of paralleling control will have to be standardized for all manufacturers so that there will be complete interchangeability of cars between trains and even between different railroads. The simpler the control schemes are, the easier it will be to standardize them.

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Tinning Aluminum Sheathed Cables

By W. E. Warner

Aluminum cable sheathing is now sometimes used in place of the more usual lead sheathing. Satisfactory wiped joints in these sheaths can be made, provided the sheath surface is first tinned.

First, the sheath surface must be well cleared using a fine file or wire brush. The most satisfactory solder for tinning consists of 90 per cent tin and 10 per cent zinc, no flux is necessary. The sheath surface is then heated by a blow torch just sufficiently to melt the solder. The solder is then rubbed vigorously over the surface, the heat serves to melt the solder while the rubbing action breaks up the film of aluminum oxide which forms rapidly.

The tinning is completed by scrubbing the molten solder into the aluminum by means of a wire brush. This will remove any remaining trace of oxide and thoroughly unite the solder with the aluminum. To do this, the solder must be in stick form. These sticks should be at least half an inch wide and preferably given a slight curvature. The sheath should only be heated enough to melt the solder.

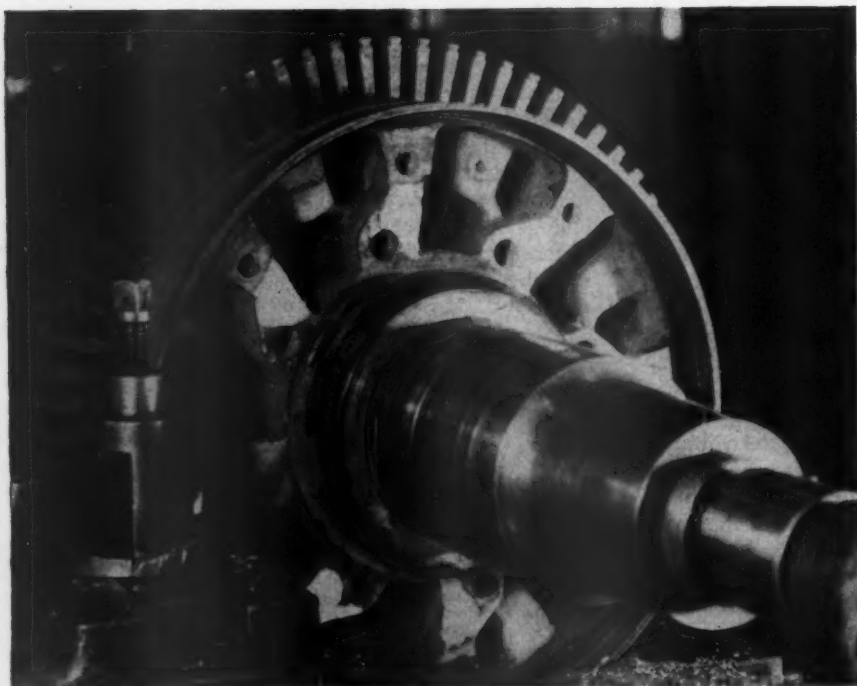


Fig. 2—The pinion end of a D-7 traction motor with the coil-support webs welded but not machined

Reenforcing Armature Coil Supports

By C. F. Steinbrink*

IT HAS been our experience that the pinion end coil support of the original E.M.D. type D-7 traction motor was not of sufficient strength to withstand the excessive vibration which this motor is subjected to in service, and consequently, this support cracks at the narrowest part of the web.

Eventually, the manufacturer developed a heavier support which has proved satisfactory but, in the meantime, many thousands of these motors were put in service, and the railroads who purchased and received early delivery of Diesel locomotives had practically all of this type of support in service.

The construction of this motor is such that the new support cannot be applied to the spider or quill without destroying the winding, and as the manufacturer did not replace the support until after it had cracked, many of the motors received on unit exchange had motors with armatures having the old support.

This, of course, is one of the faults of unit exchange. Even though the original motor received with the locomotive was of newer construction, when the original motor was sent in for overhauling, the motor received in exchange frequently had the old support. Then, if the support failed during its next mileage service, the user had to pay for a new armature.

It was to avoid this expense that we tried re-

* General Electrical Foreman, Chicago, Rock Island & Pacific.

enforcing this support. First, we chipped out only the cracked webs, and welded them only. We soon found out this was not satisfactory, as the webs which had not been reenforced had to take considerably more of the vibration, and would crack after short mileage and cause winding failures.

Figure 1 shows the pinion-end coil support of a D-7 armature before it was reenforced. Figure 2 shows the support after being reenforced with electric welding, and before it had been turned. It will

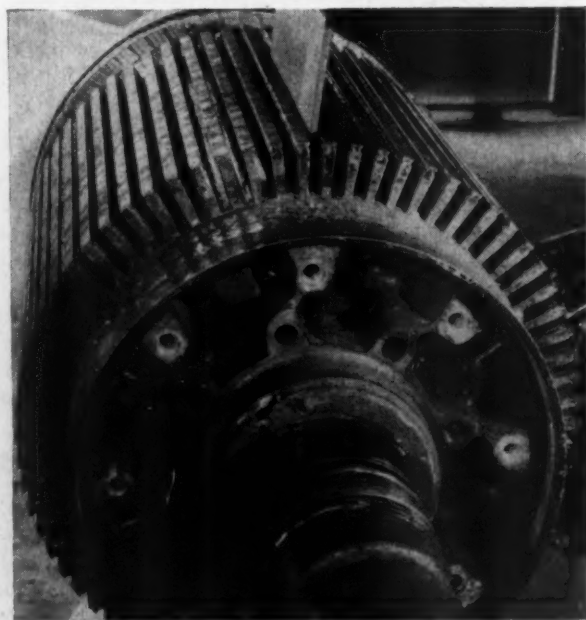


Fig. 1—A type D-7 traction motor armature showing the pinion-end coil support before weld

be noticed that only the front web is reenforced, as we found this was sufficient. To get an even heat, and not cause heat cracks, a little weld is applied at a time, and then the armature is rotated and skip welded, using a $\frac{5}{32}$ -in. mild steel rod at 140 amp. until the heat is evenly distributed, and then finishing with a $\frac{1}{8}$ -in. rod. To remove stresses set up in welding, each layer is peened with an air hammer as applied. Although approximately 12 lb. of weld metal is applied, we are able to hold the support to within .005 in. out of round.

Since these pictures were taken, the holes which formerly held the air baffle are now being welded also, and the baffle left off, since it was found to impede the passage of air through the armature.

It takes approximately eight hours labor to weld and machine this support, and we have been welding over two armatures per week for about three years, or a total of approximately 312 armatures. In the majority of cases, the armature would have been replaced with a new armature and, in some cases, the shaft and commutator could have been saved. The average saving is \$2,000 per armature, or a total saving of over \$200,000 per year.

These pictures show an armature which has had the winding removed, but in no case is it necessary to remove the winding just to reenforce the coil support.

Automatic Diesel Engine Temperature Control

The Denver & Rio Grande Western has equipped all of its 48 E.M.D. Model FT, 1,350-hp. freight loco-

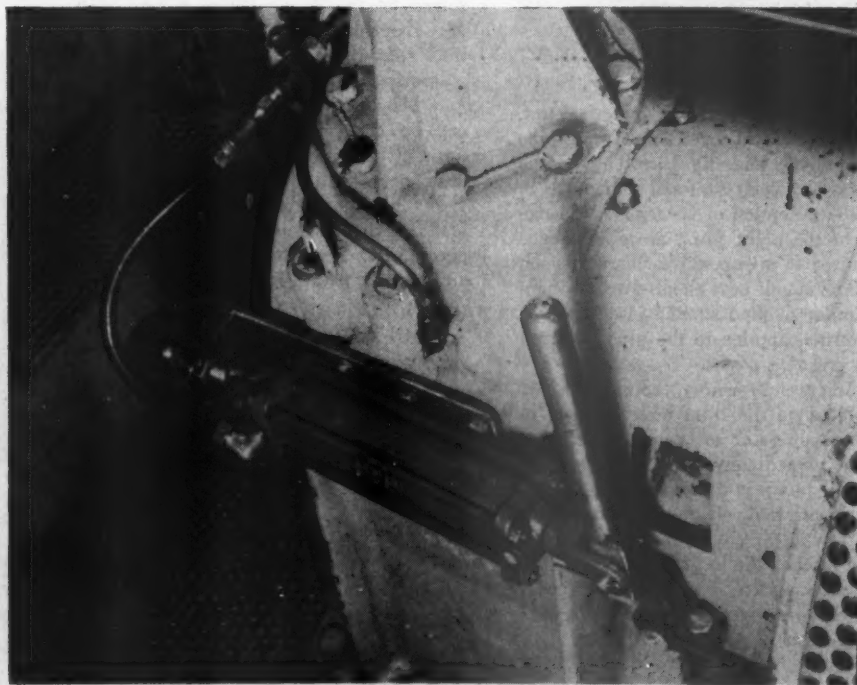
motive units with fully automatic control of engine-cooling water temperature by the installation of Minneapolis-Honeywell fully-modulated radiator shutters in conjunction with Pneu-Temp Automatic Fan-Clutch Controls for the generator-end fan clutch and the accessory-end fan clutch.

Clutch Operation

The fan clutches were originally operated manually. To obtain the best automatic operating sequence, it was found necessary to sometimes engage fan clutches at engine speeds between idle and 800 r.p.m. This is contrary to locomotive operating instructions which state that fan clutches should not be engaged at speeds above idling. This instruction is understandable inasmuch as many firemen engage clutches instantly by operating the clutch lever with their foot, a procedure which would not be desirable with the engine running at 800 r.p.m. However, the clutch size is ample, and continued operation has proven that the fan clutches may be engaged by means of pneumatic cylinders, when the rate of engagement is properly controlled, no damage is incurred to the fan clutch, fan drive belts or related equipment. This information is now confirmed by the locomotive manufacturer who recommends the installation of this type of automatic temperature control and fan clutch operation.

The radiator shutters, generator-end fan clutch and accessory-end fan clutch are all controlled by a single thermostat element. The control system is so connected that should the control air pressure fail, the radiator shutters assume full open position with fan clutches engaged. The equipment for operating the fan is known as the Pneu-Temp Fan Clutch Control. It was developed and is licensed by The Equipment and Supply Company, Diesel Division, 1422 16th st., Denver, Colorado.

Pneu-Temp fan clutch operating cylinder used to control a generator-end fan—An adjustment at the rear of the cylinder controls the final position of the clutch operating lever and an adjustable orifice in the air supply line governs the rate of engagement of the clutch



NEW DEVICES

Mechanically Operated Pipe Threader

Faster working speed, automatic chucking, lower initial cost, better, cleaner threads and a greater reduction in maintenance expense are among the operating benefits claimed for the new model Thred-O-Matic 44 pipe-threading machine brought out by the Quijada Tool Company, Los Angeles, Calif. Its range is from ½ in. to 4 in.

Mechanically-operated automatic chucks account for the high speed of the ma-



chine, according to the manufacturer. The operator is required only to lay pipe in the spindle and flip a switch and the pipe is chucked, centered and turned. With the exception of occasional resharp-ening of the eight jaws, no maintenance is required to give positive chucking each time. The chuck jaws themselves are hobbled similar to pipe wrench jaws, and the more torque applied to the pipe the firmer the gripping power.

In the cutter assembly, the cutter wheel is mounted on the front housing plate to allow the operator to place a fitting on the pipe immediately after threading.

The oil pump is driven directly by the transmission and oil flow is instantaneous. Flow is directed through the tubing located in each die head to the exact spot where the oil is needed. Spur gears mounted on precision made shafts are held in place by double shielded ball bearings.

In this unit, a large red blinker light located in an easily visible position flashes every two revolutions. The operator starts thread on first flash and threads until five flashes are counted, then opens the die head.

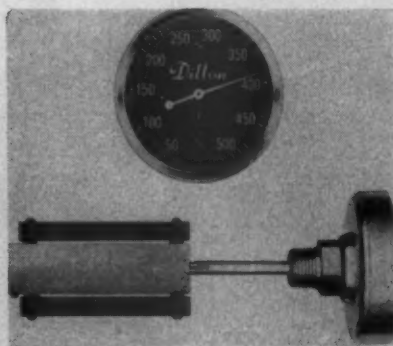
The quick opening type of die head utilizes four high speed dies in each head. One screw simultaneously adjusts all dies for changing depth of thread. Reamers are of the flat bladed type and one is attached to each die head.

A 3-hp. motor operating on a 220-volt, 3-phase, 50-60 cycle power supply provides ample power at all times. Automatic magnetic switches assure overload protection. A switch selects high speed simply by moving into left hand position and slower speed by moving to right hand position. Unchucking the jaws is performed by raising the handle to the upper position.

Flat Stem Magnetic Thermometer

There are many applications of thermometers where heat must be indicated, but because of their shape, conventional round stem instruments cannot properly perform the task. This problem has been solved by the W. C. Dillon & Co., 5410 W. Harrison street, Chicago 44, with their introduction of the illustrated unit.

Items such as electric transformers, engine blocks, air ducts, exhaust ports, etc., can be checked with this device. The large flat area quickly gathers and retains heat from the surface under test. It actually covers the heat area like a blanket whereas round stem units would permit the heat to escape past them around each side of the stem.



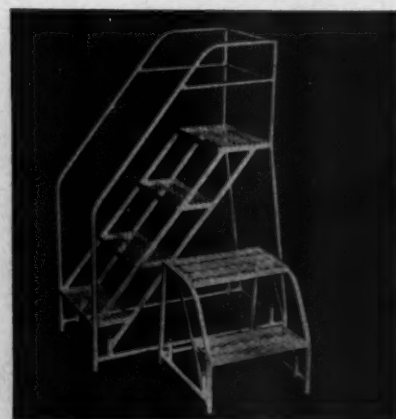
The magnets enable the operator to place the thermometer on a flat surface and "peel" it off in an instant. It saves untold time usually required for fittings of a more complicated nature.

Specifications for the thermometer include: dial sizes of 1, 2½, 3 and 5 in. diameters which are optional; stem lengths in intermediate sizes from 3 in. up to and including 42 in. long; available in either Fahrenheit or Centigrade (Celsius) calibration; crystal is sealed with double gaskets; will withstand pressures better than 3,476 lb. per sq. in.; no gears or linkages are used.

The model can be screwed into tanks, or steam lines, if desired, simply by removing the magnetic portion of the stem.

All-Steel Safety Step Ladder

A mobile step ladder is being produced by the Ballymore Company, 3 S. Roberts road, Bryn Mawr, Pa., incorporating an automatic safety feature which is effective and simple. The ladder is mounted on ball bearing casters for easy movement but the moment a person steps on the ladder, the rubber-tipped legs automatically come in contact with the floor, pre-



venting rolling action and the possibility of a fall.

Stock rooms, parts storage, filing departments and maintenance crews have proved its practicability. The ladders are made in standard sizes from one to six steps out of aluminum finished steel.

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with

Chilled Car Wheels

Savings gained *right now* are more important to Railroads than long-range economies that may not pay off.

That's the significant thing about the savings you get from Chilled Car Wheels. You get them immediately . . . when they count the most . . . when you can use them to best advantage.

With Chilled Car Wheels you profit at once with these big savings:

- Immediate and substantial savings in wheel investment and lower first cost.
- Immediate reduction in replacement and wheel shop costs.
- Immediate delivery from 26 strategically located member plants — reducing inventory requirements.
- Improved design — assuring greater safety, strength and durability.

Details of these economies can be obtained from any member of the Association of Manufacturers of Chilled Car Wheels.

Remember: *Over 65% of the nation's railroad freight is carried on Chilled Car Wheels.*

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

443 NORTH SACRAMENTO BOULEVARD, CHICAGO 22, ILL.

American Car & Foundry Co. • Canadian Car & Foundry Co. • Griffin Wheel Co.
Marshall Car Wheel & Foundry Co. • New York Car Wheel Co. • Pullman-Standard Car Mfg. Co.
Southern Wheel (American Brake Shoe Co.)



The frame is $\frac{3}{4}$ -in. steel tubing and the step plates of non-slip reinforced expanded steel are electrically welded in one sturdy unit.

Handrails are optional on the safety ladders having from three to six steps and the removable steel mesh basket is optional on all models.

Brush Stabilizer For Fractional-Hp. Motors

A device which is claimed to more than double the life of brushes and commutators in series-wound, heavy-duty motors has been developed by engineers of General Electric's Fractional Horsepower Motor Divisions.

Designed for G.E. fractional-hp. motors used in portable electric tools, the new brush stabilizing mechanism counteracts the wedging effect of the commutator and causes the brush to ride



freely in the brush holder. The mechanisms have been designed to interchange with standard mechanisms as outlined in the N.E.M.A. standardization of series-wound motor parts.

The normal cartridge type of brush holder as used on portable tools consists of a brush holder, insulating tubing, brush and spring assembly, and a brush cap.

The change to a brush stabilizing mechanism involves the use of an angular brush top plus the addition of a bracket to seat on the angular brush top. The brush spring pressure is thus partially resolved into a horizontal component which corrects the brush wedging and thus improves commutation and increases brush life.

The addition of a roller to the bracket assures close following of the brush on the commutator resulting in improved commutator life.

The G.E. line of Type BA heavy-duty series motor parts will be available with and without the new mechanism. Special applications to other types of motors using a cartridge type mechanism also are expected.

Welding Goggles With Nylon Cups

Nylon in plastic form has great compressive strength and impact resistance. Therefore it offers extra safety when eye



protection is required. More strength and less weight are features of this welding goggle with cups of DuPont nylon plastic, now being manufactured by Willson Products, Inc., Reading, Pa.

In addition to light weight, the goggle has comfort features, including rolled edges to reduce pressure around the eye socket; adjustable leather bridge and headband to assure perfect fit; triangular lenses for extra wide vision and screened indirect ventilating ports which admit air to prevent fogging, but keep out dust and flying particles. The goggle is also available with direct ventilating ports and clear, impact-resisting lenses for chipping and other heavy duty work.

Three Models Of Diesel Engines

The Harnischfeger Corporation, 100 Lake street, Port Washington, Wis., has introduced three models of Diesel engines for the railroad industry. The engines have horsepower ratings of 45, 70 and 150 for the 2-, 3- and 6-cylinder models respectively. Engine weights are 1,100, 1,350 and 1,900 lb., giving weight-power ratios of 24, 19 and 13 lb. per hp. All models operate at a maximum of 1,400 r.p.m. and at a maximum piston speed of 1,285 ft. per min.

All engine parts are interchangeable from one model to another with the exception of such parts as the crankshaft, camshaft, crankcase, etc., which are necessarily different due to the number of cylinders. The engines employ the two-



stroke cycle principle, with a bore of $4\frac{1}{2}$ in., a stroke of $5\frac{1}{2}$ in., and a displacement of $87\frac{1}{2}$ cu. in. per cylinder. The Model 387-C crankshaft has four main bearings; the Model 687-C crankshaft has seven main bearings. All pins and journals are drilled for continuous pressure lubrication.

These P.&H. Diesel engines have a patented cylinder head and liner assembly. Each cylinder is an independent, fully water jacketed assembled unit. Should it be necessary to change a piston or connecting rod it is a 40-min. service job to (1) disconnect the injector fuel line and remove the injector; (2) remove connecting rod caps through the large inspection port in the lower crankcase (it is not necessary to remove the oil pan); (3) remove four head nuts and lift out the cylinder head and liner assembly as a unit (the piston and connecting rod will lift free with the assembly); (4) install the spare power unit assembly by reversing these steps.

Three-Phase Transformers

All the advantages found in the single-phase CSPB distribution transformers for



banked-secondary operation are offered in a new line of three-phase CSPB transformers announced by the Westinghouse Electric Corporation. Designed for four-wire, 208Y/120-volt secondaries, the new transformers make possible three-phase banked-secondary operation without the possibility of cascading or reverting to radial operation found previously when banking conventional transformers. The new, three-phase transformers when used in banked-secondary systems reduce light flicker resulting from motor loads, in-



A comfortable margin of **READY POWER**

From those who have watched our new switcher in service — on the Nickel Plate, Erie, New York Central, Cincinnati Union Terminal, St. Louis Terminal Railroad and Frisco, so far — come most favorable comments concerning available power and handling.

This is due to the simplified and efficient electrical control system. But more, it lies in the fact that this locomotive has a comfortable margin of ready power. The diesel easily develops 1200 hp at 950 rpm — it provides a full 1000 horsepower to the traction motors.

Ample power will keep maintenance at a low figure. This, with the many refinements suggested by operating men, plus others conceived by ourselves, will prove out on your railroad.

Arrange to have your people take a careful look at this switcher. It is powered by our own Hamilton-built engine. It uses standard Westinghouse rotating equipment. It uses standard accessories of the highest grade.

DIVISIONS: Lima, Ohio—Lima Locomotive Works Division; Lima Shovel and Crane Division. Hamilton, Ohio—Hooven, Owens, Rentschler Co.; Niles Tool Works Co. Middletown, Ohio — The United Welding Co.

PRINCIPAL PRODUCTS: Locomotives; Cranes and shovels; Niles heavy machine tools; Hamilton diesel and steam engines; Hamilton heavy metal stamping presses; Hamilton-Kruse automatic can-making machinery; Special heavy machinery; Heavy iron castings; Weldments.



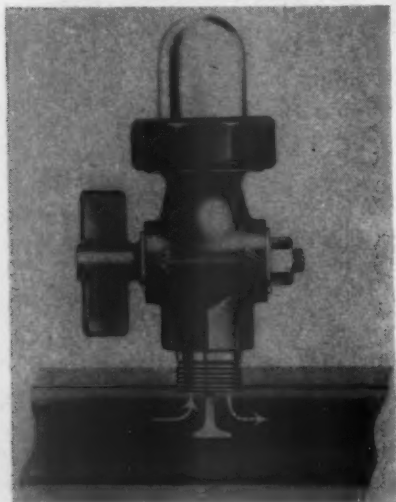
crease service reliability, and reduce necessary installed capacity.

Features of the CSP and single-phase CSPB transformers such as "loading by copper temperature" and integral surge protection are incorporated within the transformer itself. An extra secondary breaker within the transformer and additional low-voltage bushings provide proper sectionalizing of the secondary without the necessity of mounting additional equipment.

Three-phase CSPB transformers are available in the 75-kva. rating in standard high-voltage ratings from 2,400 to 14,400 volts inclusive.

Valve Type Sight Glass

Originally designed for observing the clarity of hot water passing through Worthington Hot Process water treating systems, the valve type sight glass can be



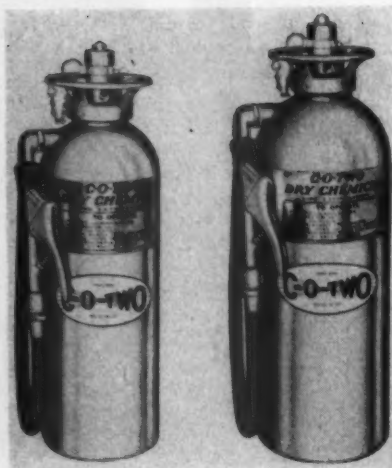
used in any system through which transparent liquids flow.

The clarity or turbidity of transparent liquids flowing under pressure through pipe lines can now be observed by means of this valve type sight glass, manufactured by Worthington Pump & Machinery Corp., Harrison, N. J.

Differential pressure is established across the deflector to allow some of the liquid to circulate continuously through a glass observation bowl. A special feature is provided by the valve which permits the removal of the observation bowl for cleaning.

Dry Chemical Fire Extinguisher

The C-O-Two Fire Equipment Company, Newark 1, N. J., has completed development of its newest contribution, the dry



chemical type fire extinguisher.

It is a self-contained unit with no extra gadgets protruding or complicated operating instructions. The dry chemical is free flowing, with no syphon tubes or valves within the cylinder to become clogged or inoperative. The discharge hose and nozzle remain empty until the fire extinguisher is actuated.

Two convenient sizes are available to fit fire fighting needs, one of 20-lb. capacity and the other of 30-lb. capacity. Approved by the Underwriters' Laboratories, Inc., their rating is B-1, C-1. C-O-Two. Two dry chemical is non-conducting, non-corrosive, non-freezing, non-toxic and is effective on flammable liquid and electrical fires.

When the chemical is spent, on-the-spot recharging is possible. Dry chemicals for recharging are available in handy premeasured 20- and 30-lb. sizes as well as in a 50-lb. bulk size, all sizes packed in durable moisture proof containers.

Strip Abrasive Drum Sander

Shops concerned with the problem of using polishing and buffing abrasives in endless belt form can now take advantage of a 75 per cent saving in abrasives by using it in strip form on a new type



buffer drum developed by the American Diamond Saw Company, 519 N. W. Park avenue, Portland 9, Ore.

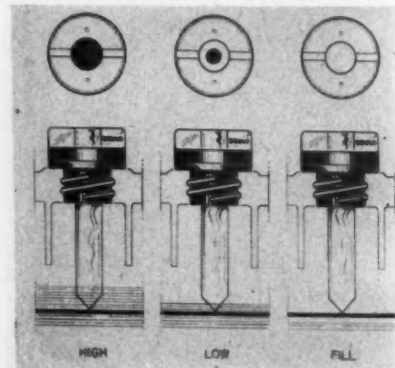
It is a split drum, cushioned with rubber, the halves of the drum being locked into a solid drum by a cone type washer and permits the use of less expensive standard strip abrasives. Its light weight makes it highly adaptable for use with a flexible shaft as well as on a stationary arbor.

Standard width abrasives, available in roll form, are wrapped around the drum and secured into place by pins that recede out of the way when the cone washer is tightened down. During buffing, polishing or grinding operations, the wheel does not lose diameter or need dressing. Abrasive cloth in various grits can be quickly interchanged on the same drum to accommodate rough or fine work.

The new "Cone-Loc Drum Sander" is available rubber cushioned, in sizes from 6 1/4 in. to 12 in. diameter and various standard widths and bores. A 6 1/4-in. felt cushioned sander is also available.

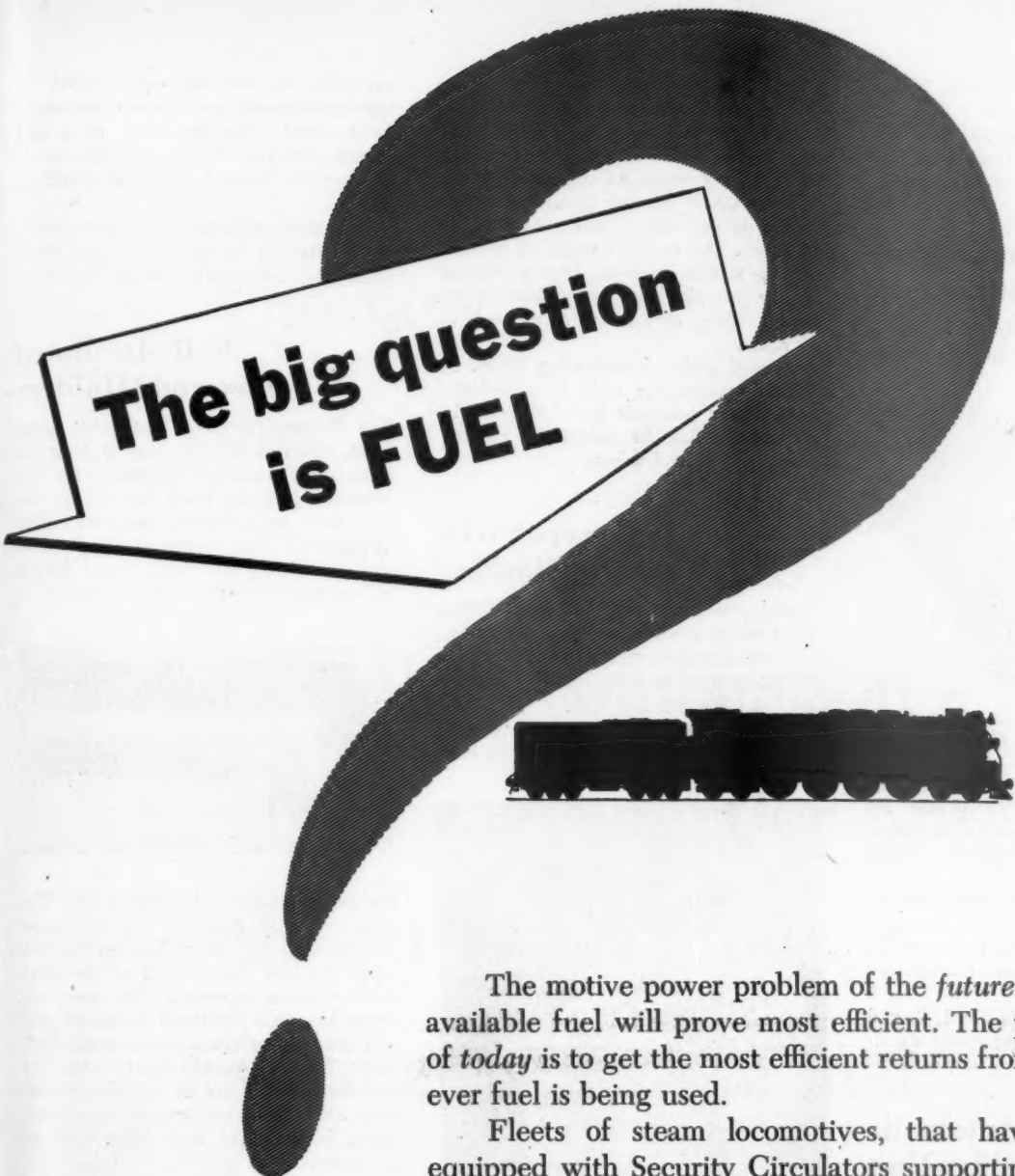
Battery Vent Plug Shows Electrolyte Level

The Gould Storage Battery Corporation, Trenton, N. J., announces a translucent plastic vent plug, named the "Telelevel," which shows at a glance whether the battery needs water. Maintenance men may



determine electrolyte levels without unscrewing the "Telelevel."

The translucent plug has a cylindrical element which projects down into the electrolyte. The portion of the element which extends into the electrolyte is cone-shaped. When the electrolyte is at the correct level, the cone is completely covered. Light waves traveling down the element are absorbed into the electrolyte and not reflected. The top of the plug shows a black circle, indicating that no water is required. When the electrolyte is low, the cone is not covered by the electrolyte and light waves are reflected back up the element from the electrolyte



**The big question
is FUEL**

The motive power problem of the *future* is what available fuel will prove most efficient. The problem of *today* is to get the most efficient returns from whatever fuel is being used.

Fleets of steam locomotives, that have been equipped with Security Circulators supporting properly proportioned brick arches, show definite gains in performance in relation to the fuel consumed. Such installations have been made by fifty railroads, in twenty-five different types of locomotives.

Many other existing locomotives could be continued in profitable service if equipped with Security Circulators to improve their operation.

* * *

The Security Dutch Oven, recently developed and introduced by the American Arch Company, has already been installed in over two hundred oil-burning steam locomotives, to increase efficiency of combustion and aid in improving steaming qualities.

American Arch Company Inc.

NEW YORK • CHICAGO

RAILWAY MECHANICAL ENGINEER, OCTOBER, 1949

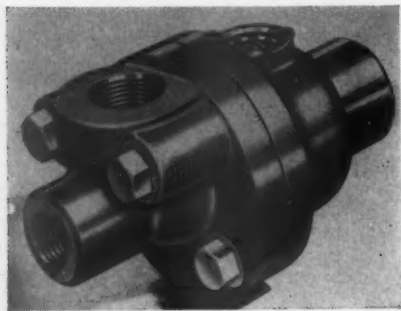
103

surface. A white circle appears, indicating that water is required.

The "Telelevel" is available at slight extra cost for all new Gould "Z" type batteries, both "Thirty" and "Kathanode."

High Temperature Rotating Joint

This rotating joint is designed for steam, hot water, oil, or other liquids. Its maxi-



mum working pressure is 150 lb. steam at rotating speeds from 150 to 300 r.p.m.

Although the illustration shows female end connections, male or flange ends are optional on these units designed and manufactured by the Chiksan Co., Brea, Calif.

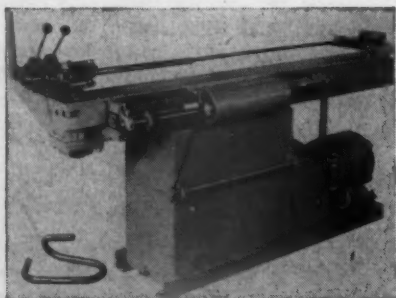
Easy turning is made possible through the use of stainless steel ball bearings and the seal is not affected by corrosion, contamination or sudden temperature changes.

The devices are available in 1, 2, and 2½ in. sizes, others being under development.

Semi-Automatic Tube Bending Unit

For the handling of production jobs and maintenance bending work requiring frequent changeovers, the Pines Engineering Co., Aurora, Ill., has announced the illustrated semi-automatic hydraulic pipe bending machine.

Designated as series 1400 bender, it can handle tubes and pipes up to 5 ft. in length. The maximum rated capacity is 1 in. outside diameter, 15 gauge tubing (steel) with a maximum bending radius



of 8½ in. to the centerline of the tube.

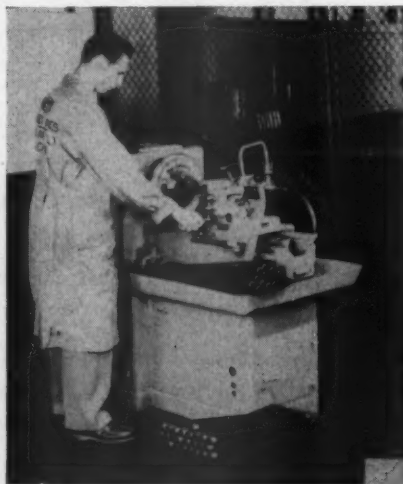
The machine's movements are controlled by two toggle-operated hand-clamping levers and one manual hydraulic valve control lever. An adjustable angle-of-bend turret permits instantaneous selection of any one of four pre-set angles of bends. The unit is capable of producing up to 400 bends an hour depending on the material. The hydraulically operated bending arm moves at a speed of 29 r.p.m.

A steel pedestal measuring 18 in. by 40 in. mounts the unit. This pedestal serves as a reservoir for the hydraulic oil and as a base for mounting the motor, pump and control valves.

Power-Driven Threading Machine

Speed selector switch and push button controls for standard voltages are among the time-saving features of the production threading machine identified as the Oster No. 72 "Wilco."

Versatility is demonstrated by its ability to thread short lengths of pipe on both



ends such as 2 in. pipe only 3½ in. long, without using a nipple chuck. Regular pipe range is ¼ to 2 in., extra pipe range ½ in. and bolt range ¼ to 1½ in.

With this unit, available from The Oster Mfg. Co., Cleveland 3, Ohio, faster threading and minimum handling of stock are offered by a 3-speed motor (900-1,800-3,600 r.p.m. and spindle speeds 40-80-160 r.p.m.); worm gear drive with ball bearing mounted spindle; the wrenchless front chuck with easy-to-grip chuck wheel; non-locking rear centering chuck; the quick-opening, adjustable die-heads with segmental dies; length gauge for quick setting to size for threading and the calibrated gauge for setting to desired length of pipe for cutting-off; individual drive centrifugal coolant pump with coolant line in front of die head.

Carriage and die-head support the

operating unit with flat ways on bed. A carriage operating lever is used instead of hand wheel. Carriage travel is 12 in.; length of ways is 30 in.; spindle bore is 2½ in.; and height to center of spindle is 38 in.

The maximum length of thread cut without regripping stock is 14½ in. Floor space required is 2 ft. 3 in. by 5 ft. 10 in.

Fully-Insulated Electrode Holders

The Bernard Welding Equipment Company, Chicago 19, is now making its "shortstub" electrode holders with the electrode gripping head completely covered with an insulating material called "lifeguard." The holders make it possible to deposit the total fluxed length of welding electrodes which results in



the lowest possible electrode waste. The new insulation material was developed to withstand the direct heat of the arc when the last coated inch of the electrode is being deposited. The new insulation has high resistance to impact and will not chip or crack under rough handling. Since all outside metal surfaces of the electrode holders are completely covered with insulation, danger of electric shock is minimized even when used in wet areas.

Safety Spectacle

A safety spectacle has been developed under the trade name "Saf-I-Spec" which has several interesting features. The manufacturer claims that this spec offers maximum protection from impact hazards where spectacle type safety goggles are recommended and that employees accept it because of lightness and comfort. It is manufactured by the United States Safety Service Co., Kansas City 6, Mo.

One of the features is a one piece lens which can be replaced or adjusted instantly. Patented, quick detachable temples may be attached to the outside edge of the lens, making it possible for the wearer to adjust the temples to the position desired. The lens has an integral molded sweat-bar which gives rigidity and prevents it from getting out of alignment. This safety spectacle can also be adjusted to wear over personal glasses.

The one piece lens is made from Opti-

The new Electro-Motive
fuel injector will operate
on fuel of 40 cetane rating
with less combustion shock
and lower cylinder pressures
than the old injector
with a 55 cetane fuel.

*Result: Broader fuel range—
Better fuel economy.*

ELECTRO-MOTIVE



DIVISION OF GENERAL MOTORS • LA GRANGE, ILL

Home of the Diesel Locomotive

lite, a plastic which meets government specifications for impact and piercing resistance. The lenses are optically correct and are available in crystal clear or anti-glare green. Detachable temples are permanent equipment and can be refitted over and over again to replacement lenses.

Positive Grip Multiple Jaw Wrench

A multiple-jaw, positive grip wrench for holding pipes and solid rounds up to 2 in. in diameter has been developed by the American Machine Works, Inc., Racine, Wis.

The new link-grip wrench is made with seven hardened jaws. As a result, instead of having only two opposed jaws



contacting the surface, all jaws in contact grip the work around its entire periphery. Pressure is equalized on each jaw, producing a firm, steady torque for either tightening or loosening.

Individual male and female links of the wrench pivot on hardened pins. The links move freely in either direction, making it possible to "thread" them behind close fitting pipes.

The device has a malleable handle, heat treated for strength and toughness. The link lock is also heat treated and hardened. Pins in this lock engage the handle notch and an open slot in one of the links. There are no threaded screws or nuts of any kind to adjust in fitting the wrench to the pipe. The opposite male end link fits in a clevis in the handle. Held in place with a hardened pin, it pivots to either the right or left.

All types of pipe fittings and unions can be handled with the wrench. The straddle arrangement of the female serrated links

provides necessary space in which fitting shoulders seat. The male jaws easily grasp the shoulder as torque is applied. The wrench may be released by reversing the pressure on the handle.

Positive Action Locknut

Exact nut adjustment and speed of application are features of the illustrated locknut manufactured by the Security Locknut Corp., 1815 N. Long ave., Chicago 39. It consists of a standard steel nut and an elliptical retainer ring combined into a single unit. These locknuts can be used for applications where excessive vibration is encountered.

When the unit, which is available with National coarse and fine threads in sizes from $\frac{3}{8}$ in. to $2\frac{1}{2}$ in., is applied, the bolt forces the steel retainer into circular shape while gripping the bolt threads. Automatic locking of the nut on the bolt does not require any tension.

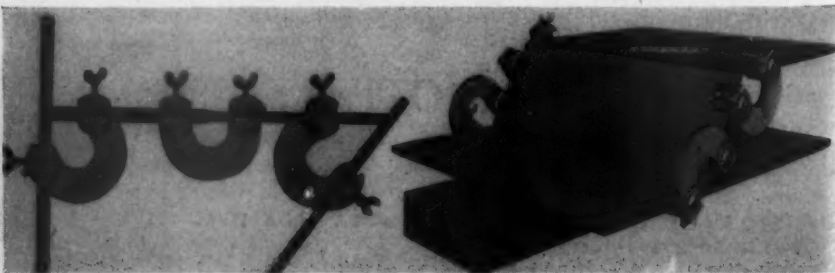
As the retainer ring grips the bolt, this portion of the assembly is automatically isolated from bearing contact and functions as a lock to prevent the nut from turning. Position of the nut on the threaded part can be adjusted at any time.

Protractor Type Welding Clamp

Illustrated is a new tool, the Pro-Clamp, which according to the manufacturer has many uses in metal-working industries. It was created to hold plates, bars, tubing, etc., while those parts are united by welding, brazing, or soldering.

Through the use of this clamp, made by the Bernard Welding Equipment Co., 741 E. 71st st., Chicago 19, piping systems and weldments can be assembled before the first weld is applied. Special fixtures and templates are eliminated in a high percentage of cases.

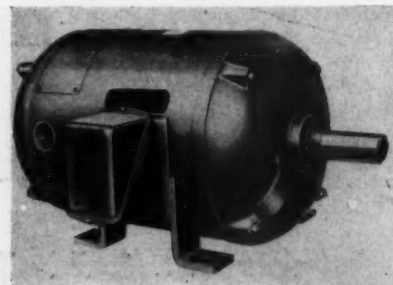
The clamps are formed like a pair of arms fashioned from a U-shaped frame which grips parts held in place for welding. These arms can be preset at any angle from 0 to 180 degrees as the frame is inscribed with two protractor scales. The unit accommodates thickness and diameter from 0 to 1 in.



Wound-Rotor Motors

The Crocker-Wheeler Electric Manufacturing Company, Division of Joshua Hendy Corp., Ampere, N. J., has announced its new Form BW protected-type wound-rotor motor, built in N.E.M.A. frames 224-505 in ratings up to 100 hp., and in larger frames up to 2,000 hp.

Frames and end shields are drip-proof. In addition to the standard drip-proof

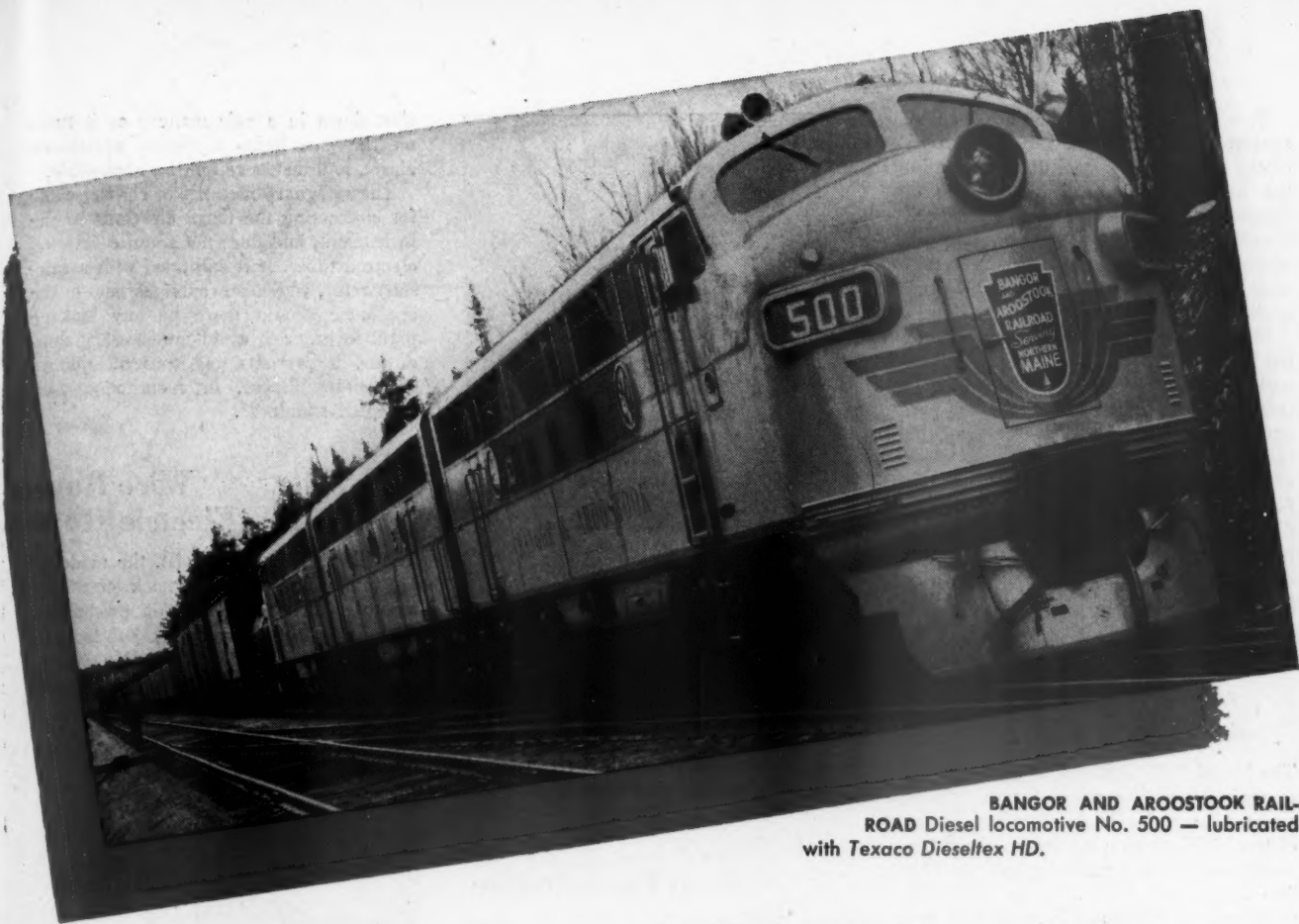


enclosure, these motors are available in splash-proof, and totally-enclosed non-ventilated types. Other mechanical modifications include N.E.M.A. floor-, side-wall-, and ceiling-mounting assemblies, and N.E.M.A. C face and D flange mountings. Both C face and D flange motors are available for horizontal or vertical operation, with or without feet.

The motors are designed for applications requiring smooth acceleration, high starting torque with low starting current, ability to start and stop or reverse frequently, or variable speed. They are suitable for driving conveyors, fans, compressors, etc. Special windings are available for crane and hoist service.

Corrosion-Resistant Stainless-Clad Steel

A corrosion-resistant stainless-clad steel is being manufactured and marketed under the trade-mark Permaclad by the Alan Wood Company, Conshohocken, Pa. The sheets consist of a layer of stainless steel inseparably diffusion-welded to a mild steel backing. The result is a sheet with maximum corrosion resistance on one side, yet which possesses the ductility and other physical properties of plain carbon steel.



BANGOR AND AROOSTOOK RAILROAD Diesel locomotive No. 500 — lubricated with Texaco Dieseltex HD.

Diesels

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Cleaner

That's the "inside story" of why more and more locomotives are being lubricated with Texaco Dieseltex HD

CLEAN top decks . . . free rings . . . absence of harmful carbon, varnish and gum . . . minimum wear . . . you'll find all these at scheduled overhaul periods when engines are lubricated with *Texaco Dieseltex HD*. These benefits mean more mileage between overhauls, better performance, greater efficiency and economy.

Texaco Dieseltex HD designates the finest in railroad Diesel engine lubricating oils . . . detergent and dispersive oils that meet the most exacting requirements of leading Diesel locomotive builders and the most severe conditions of operating service. An exclusive formula containing a special heavy-duty additive assures exceptional resistance to oxidation and sludge formations.

Talk to a Texaco Lubrication Engineer — a practical railroad man who'll be glad to explain how Texaco Products and unique Systematic Engineering Service can help you get the best performance at lowest cost from your Diesels. Call the nearest Railway Sales Division office listed below, or write The Texas Company, *Railway Sales Division*, 135 East 42nd Street, New York 17, N. Y.

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FOR ALL RAILROAD DIESELS

Tune in . . . TEXACO STAR THEATRE presents MILTON BERLE every Wednesday night. METROPOLITAN OPERA broadcasts every Saturday afternoon.

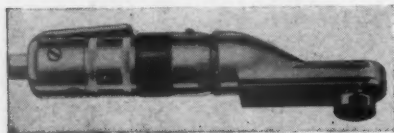
Permaclad can be metal arc welded, spot-welded or soldered. The conductivity of the mild backing steel dissipates welding heat and minimizes the danger of destroying stainless properties. Polished Permaclad can be drawn or stamped without injury to its surface if protected with one of several plastic coatings available.

The stainless layer is 10 per cent of the total thickness of sheets No. 13 gauge and heavier, and 20 per cent of the thickness of lighter sheets. The percentage of cladding, however, can be increased as desired, and special types of stainless or stabilized grades can be furnished to meet unusual corrosion conditions. All can be supplied polished or unpolished as specified. Special types of backing steels are also available, including AW Dynalloy high-strength low-alloy steel.

Air-Powered Electrode Dresser

The Model 7165, lightweight portable tool is equipped with a cutter for re-shaping copper electrodes on spot welding machines without removing the tips from the machines. The tool was developed by The Aro Equipment Corp., Bryan, Ohio, in collaboration with manufacturers who use multiple welding machines.

One of the features of the unit is its 1,200 r.p.m. cutting speed. This speed is also a factor in increasing the number of



electrodes that can be dressed in a given time with the tool.

Another feature is the type of cutters used. The combination of the correct angle on the cutter blade, and the speed of the tool permit the blade to cut faster, and at the same time, disperse chips. Cutters for No. 1 and No. 2 dome-type electrodes and No. 1 and No. 2 pointed or tapered-type electrodes are available.

The use of driving gears, fully supported on needle or ball bearings make for smoother performance and longer gear life.

Selenium Rectifiers

Oil-immersed, selenium rectifiers in tanks for outdoor and top-of pole mounting are now being made by the Clark Electronic Laboratories, Palm Springs, Calif. Called Celab rectifier tanks, they are available in sizes from 1 to 100 kw. They have no moving parts and the manufacturer states that their life is unlimited.

Some of the larger sizes are oil-filled



A 20-kw rectifier for producing d.c. power from a three-phase a.c. source

and water-cooled. Units may be connected in parallel to supply a larger load, since they automatically equalize without an operator and cannot feed back like motor-generator sets or rotary converters. They do not cause radio interference. The tanks are made of welded aluminum or stainless steel.

Rust Preventative

A rust inhibitor named EWH Formula, and utilized for the protection of metals in industry, is now available. It is manufactured by Temperature Equipment Corp., 4505 Euclid ave., Cleveland, Ohio. The formula provides a protective coating for all metals and plated surfaces against rust, corrosion, pitting and tarnish.

The preventative provides a tough, transparent and colorless coating that will withstand weather, heat, cold, grit, grease, etc. It can be removed with standard acetates. It is not a plastic and is claimed not to discolor or turn brown.

The formula can be applied by brushing, spraying or dipping. It dries in two minutes and can be handled in five minutes. In 4 to 8 hours, it reaches a hardness and adhesion equal to baked enamel and will withstand a 180 degree bend. It is available in 8-oz. and 1 gallon cans.

Electronic Combustion Control

Protection of gas-fired furnaces, ovens, boilers, and similar industrial equipment from the danger of gas explosions during ignition, operation and shut-off is provided by a unit known as the Electronic Pyrotrol, available from The Bristol Co., Waterbury, Conn., which performs the operations of lighting a gas appliance that are recommended for absolute safety.

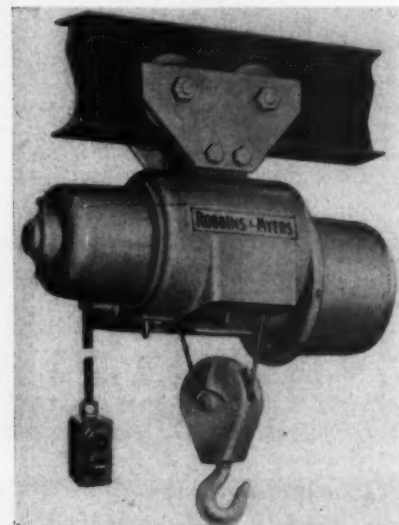
If normal operation fails at any step, the lighting-up cycle stops and closes any valve that has been opened. Should the power supply fail, the entire system is

shut down in a safe manner as it turns off the gas, lights a signal, sounds an alarm, and makes relighting impossible.

The safeguard uses BX or coaxial cable for connecting the flame electrode to the instrument, and does not require selected electron tubes. It is equipped with a safe-start relay, which prevents gas flow to the appliance should there be any leakage path. In order to avoid unnecessary shut-downs, it prevents gas shut off due to momentary flicker, in accordance with accepted standards.

Wire Rope Electric Hoist

The illustrated utility hoist, the model J, is suitable for stationary, hook, or trolley mounting in small shops, on production floors, and in receiving dock and loading areas and is available in ¼-, ½-, and 1-ton capacities with pendent rope or push



button control. It is designed for general handling operations and special lifting requirements in industrial use.

All models are equipped with totally-enclosed, ball bearing motors. Designed and built by Robbins & Myers, Inc., Springfield, Ohio, these motors develop high starting torques required in hoisting service. An electrically activated, shoe-type motor brake provides instantaneous stopping; assures accurate spotting of loads.

An oversize Weston load brake, with non-reversing clutch, automatically controls speed when the load is lowered and prevents dropping in the event of power failure. Safety-enclosed hook blocks and drop-forged steel hook swivels prevent uneven or jerky lifting by eliminating twisted and jammed cables. Adjustable for various beam sizes, trolley assemblies are equipped with ball bearing wheels.



"They just washed Casey's engine with Wyandotte Rillor"

Casey is visibly impressed with the cleanliness of his locomotive. But he'd be even more impressed if he saw how quickly and economically engines, tenders and passenger coaches are washed with *Wyandotte Rillor*.

Rillor is a mildly alkaline cleaner with unusual wetting and soil-suspending power. In solution, it *clings*

as it *cleans*, remaining on vertical surfaces long enough to penetrate and loosen dirt, oils and traffic soil. Finally, it rinses freely — even after drying on — and leaves a bright, attractive surface with a glossy sheen.

Rillor is completely safe to use on paint and lacquer finishes.

We will be glad to demonstrate the advantages of Wyandotte Rillor,

at your convenience and without obligation. May we send you detailed information?

WYANDOTTE CHEMICALS CORPORATION
Wyandotte, Michigan • Service Representatives in 88 Cities



NEWS

Diesel Manufacturers Appoint R. S. Ogg Educational Director

ROBERT S. OGG has been appointed educational director of the Diesel Engine Manufacturers Association, succeeding Ervin L. Dahlund, who resigned from this



Robert S. Ogg

position on June 1. Mr. Ogg comes to the D.E.M.A. staff from the Lima-Hamilton Corporation, Hamilton, Ohio, where he has been for a number of years in the engineering department. A large part of Mr. Ogg's time will be spent with the accredited mechanical engineering schools of the country. The remainder will be with the engineering departments of the Diesel engine builders and the 41 manufacturers of parts, accessories and oils for Diesel engines that are assisting with this educational program.

University Studies M. U. Diesel Sets

DIESEL motor trains with multiple-unit electric controls, as used in the Netherlands since 1934, may provide a basis for reducing costs and increasing revenues of passenger trains in the United States. This is one of the conclusions reached in a research study of Diesel motor trains throughout the world, conducted by the Department of Transportation at Northwestern University, Chicago.

Stanley Berge, associate professor of transportation, who has been in charge of this research, announced recently

that a complete documented report of the project will be released later this summer. He stated that the basic Dutch design, consisting of a three-car articulated Diesel motor train, with two engines mounted in the center car, can be run for approximately half the cost of an equivalent steam train. This makes it possible, he said, to double suburban or main-line train service without exceeding present steam train costs. The Diesel motor train, which carries passengers or other payload in the power car, can be run for considerably less cost than a comparable train with a Diesel locomotive, according to the study.

The study notes: "Following the extensive application of Diesel motor trains by the Netherlands railways, an observed increase in traffic took place.

"In 1938 a cost comparison was made between one of the three-car Diesel-electric motor trains and a steam-driven train consisting of a locomotive and four coaches. The cost of operating the motor train was .61 guilders per mile as against 1.30 guilders per mile for the steam train, a reduction of about 54 per cent.

"In November, 1948, the reported operating cost per train-mile for a Diesel-electric motor train, consisting of two

three-car sets having a capacity of 336 seats, was 2.90 guilders (\$1.10). For a steam train consisting of a locomotive and five coaches with a capacity of 343 seats, the figure was 3.15 guilders (\$1.19) per mile. In these figures, the costs for repair, maintenance, interest and depreciation are included."

Miscellaneous Publications

FINISHES FOR ALUMINUM.—Reynolds Metals Company, 2500 South Third street, Louisville 1, Ky. Revised edition. 124 pages, 6 in. by 9 in.; wire bound. For engineers, metallurgists, finishing department foremen, and other officers requesting it on company letterhead. The book furnishes basic information on various processes for applying surface finishes to aluminum, as well as the characteristics of the finishes so produced. It includes chapters on Characteristics and properties of Aluminum, Cleaning Treatments, Mechanical Finishes, Chemical Treatments, Electrolytic Oxide Finishes, Electroplated Finishes, Organic Finishes, Special Purpose Finishes, Controls and Tests, and considerable tabular matter on finishes for aluminum.

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE SEPTEMBER ISSUE

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Canadian National	2 ¹	Flat	Canadian Car & Fdry.
Louisville & Nashville	100 ²	70-ton covered hopper	Pullman-Standard
New Jersey, Indiana & Illinois	50 ³	50-ton box	American Car & Fdry.
New Orleans Public Belt	7 ⁴	70-ton covered hopper	Thrall Car Mfg. Co.

¹ For delivery early in 1950. The cars will be of the depressed center type. Capable of carrying an axle load of 225 tons, the cars will be 60 ft. long and 10 ft. wide at the depressed center section which, at a height of 2 ft. 4 in. above the rail, is lower than in the ordinary depressed center car. Intended primarily for shipment of heavy transformers, the cars will have at each end six-wheel trucks with one-piece frames and special wheels and axles; they also will have special air-brake arrangements. The car frames will be one-piece castings with holes in the center section for anchoring the loads.

² The cars, which will cost approximately \$6,000 each, are scheduled for delivery in November.

³ Delivery to begin early in the present quarter of 1949.

⁴ To cost approximately \$5,246 each. For delivery late this year.

NOTES:

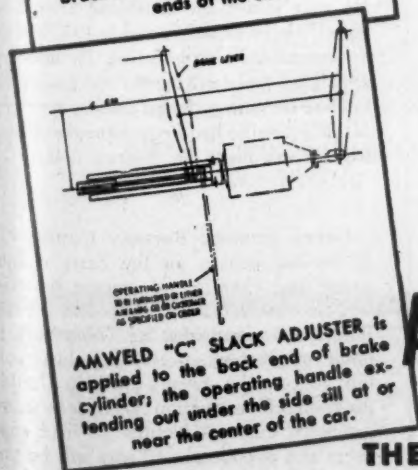
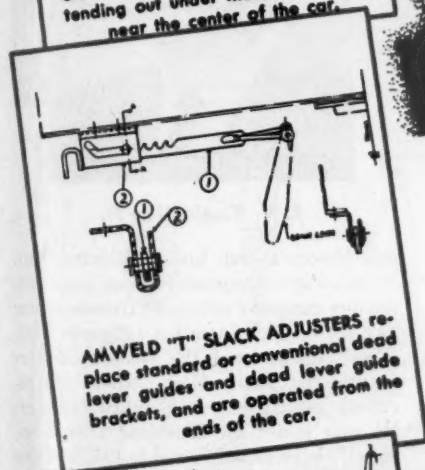
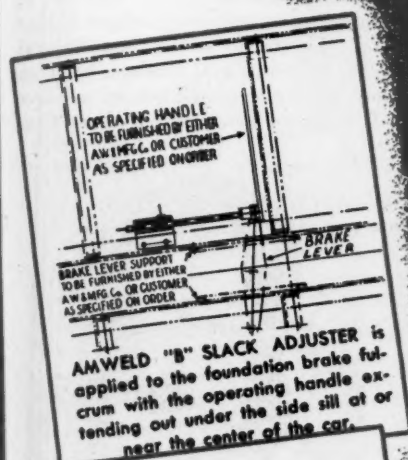
Delaware, Lackawanna & Western.—Delivery of 15 new streamline coaches and nine sleeping cars containing rooms and roomettes, ordered by the Lackawanna as part of its postwar modernization program, has been completed by the American Car & Foundry Co. The modernization program includes still another group of streamlined coaches being built by the Pullman-Standard Car Manufacturing Company, and dining cars and observation-lounge cars being built by the Budd Company, all of which will be delivered after September 1. Each new coach accommodates 64 passengers, and each sleeping car contains six double bedrooms and 10 roomettes, equipped with individual light, heat and temperature controls.

Long Island.—The Long Island has requested court authority to purchase eight 2,000-hp. Diesel-electric passenger locomotives from Fairbanks, Morse & Co. In their petition the road's trustees said six of the new locomotives would cost \$1,260,000, of which \$1,239,000 would be accounted for by unexpended funds in an equipment trust, thus necessitating new expenditures of only \$21,000. The other two locomotives will be bought out of savings caused by use of the first six. Purchase of the Diesels, the petition added, would permit retirement of nine steam locomotives.

Northern Pacific.—The board of directors of the Northern Pacific has authorized the purchase of six 6,000-hp. Diesel freight road locomotives and 12 1,000-hp. Diesel switchers, at an approximate cost of \$4,000,000.

AMWELD BRAKE SLACK ADJUSTERS

are in use on these railroads



Chesapeake and Ohio R. R.
Cudahy Car Lines
Erie Railroad Company
Ford Motor Company
New York Central R. R.
General American Trans. Corp.
Mather Stock Car Company
New York, New Haven & Hartford R.R.
Norfolk and Western R. R.
North American Car Corp.
Union Railway Co.
Virginian Railway
Wheeling and Lake Erie R. R.
Baltimore & Ohio R. R.
Delaware and Hudson R. R.
Interstate Railroad Company
Southern Railway System
General Chemical Division

Citrix Service Oil Company
Western Maryland R. R.
Delaware, Lackawanna & Western R. R.
St. Louis-Southwestern Railway Co.
Chicago, Rock Island and Pacific R. R.
Central Railroad Co. of New Jersey
Duluth, South Shore & Atlantic R. R.
Escanaba & Lake Superior R. R.
Nashville, Chattanooga & St. Louis R. R.
St. Louis-San Francisco R. R.
Shippers' Car Line Corp.
.....and orders have been received from:
Mexican Petroleum Corp.

More and more railroads are recognizing the superiority and many advantages that accrue from using AMWELD Brake Slack Adjusters. Three models, "T", "B", and "C" are adaptable and easily installed on most types of freight cars.

- Your request for information regarding AMWELD Brake Slack Adjusters will bring complete data including application prints.

AMWELD RAILWAY EQUIPMENT

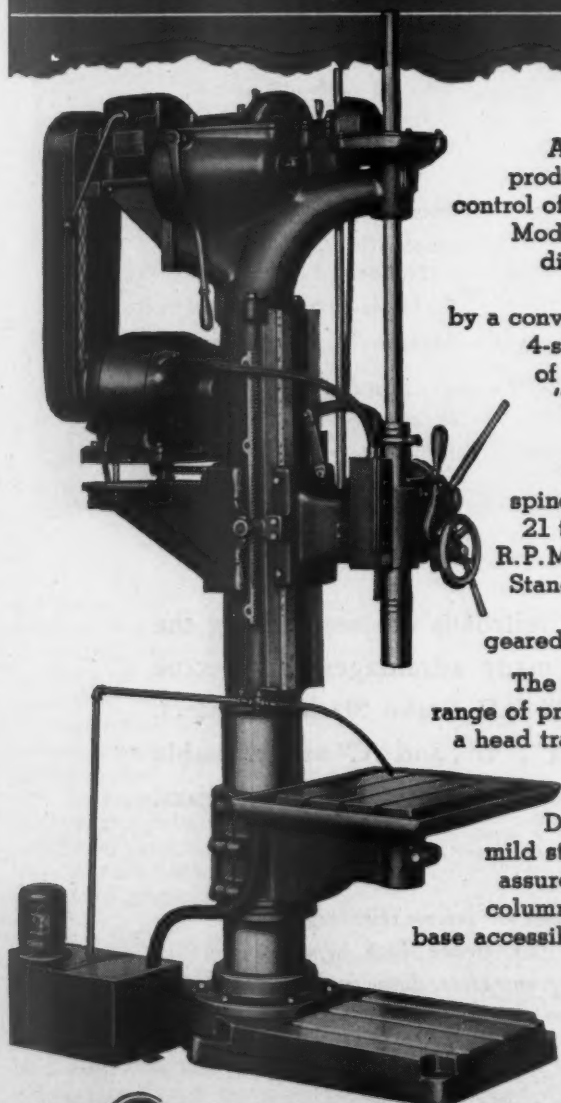
Division of

THE AMERICAN WELDING & MANUFACTURING COMPANY
260 DIETZ ROAD • WARREN, OHIO

NOTICE

The New

SIBLEY MODEL D DRILLING MACHINES in 24" and 28" SWING



An operator gains greater productivity from the ease of control offered by the new Sibley Model D. The V-belt drive is direct to a 4-speed geared transmission, controlled by a conveniently located lever. A 4-station switch at the front of the machine includes an "inching" button to facilitate changing speeds.

Three optional ranges of spindle speeds are available: 21 to 365 R.P.M.; 25 to 419 R.P.M.; and 37 to 650 R.P.M. Standard equipment includes automatic spindle stop; geared power feeds; back gears.

The Model D handles a wide range of precision drilling jobs with a head travel on the hand scraped column of 25" and a spindle feed of 11".

Drilling capacity is 1 3/4" in mild steel. The heavy table arm assures rigidity and swings on column, to make the machined base accessible for a working surface.

Model D-24 Drilling Machine is illustrated complete with coolant pump and fittings, electrical reversing, 5 H.P. motor, magnetic starting switch, and rectangular oil groove table.



SIBLEY MACHINE & FOUNDRY CORP.
119 East Tutt St., South Bend 23, Indiana
Send Catalog No. 68

Name _____ Title _____
Company _____
Address _____
City _____ State _____

SUPPLY TRADE NOTES

AJAX-CONSOLIDATED COMPANY. — The Mount Royal Specialties Company, Ltd., Sun Life building, Montreal, Canada, has been appointed Canadian distributors for Ajax-Consolidated Da-Lite control blinds, automatic slack adjusters, and Sure-Flo sanders; Coach & Car Equipment Co. seats, and Jenkins leather fibre dust guard adjusters.

GENERAL MOTORS DIESEL, LTD.—E. V. Rippingille, Jr., formerly manager of plant No. 2, Electro-Motive Division, General Motors Corporation at Chicago, has been appointed president and general manager of G. M.'s new Canadian subsidiary, Gen-



E. V. Rippingille, Jr.

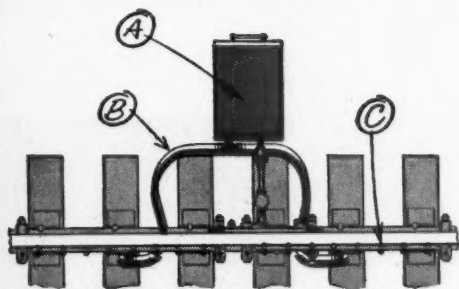
eral Motors Diesel, Ltd., at London, Ont. As noted in the September issue, page 533, the new company will build Diesel-electric locomotives for Canadian railroads. Mr. Rippingille entered the General Motors Institute at Flint, Mich., where he received training as a mechanical engineer. He next joined the Cleveland Diesel Engine Division of G. M., and in 1937 became a foreman at Electro-Motive. He later was appointed assistant master mechanic, and in 1942 became assistant factory manager. Mr. Rippingille had been manager of Electro-Motive's plant No. 2 since 1946.

GOULD STORAGE BATTERY COMPANY.—A five-day course on the care, maintenance and charging of storage batteries will be conducted by the Gould Storage Battery Corporation at its Trenton, N. J., plant on November 14-18, inclusive. In the course, the twenty-third in Gould's program of instruction to battery users, seventeen different lectures by field engineers and outside consultants will be presented. Expenses, including hotel, transportation and meals (except lunches,

STANDARD ENGINEER'S CASE FILE



Case 1141—Reducing Wear on Rails at Curves



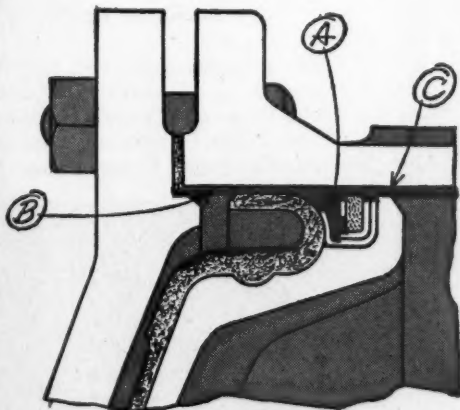
AUTOMATIC RAIL AND FLANGE LUBRICATOR

Car and engine wheels carried Calol Rail and Flange Lubricant and lubricated rails for a distance of more than two miles from an automatic lubricator. Calol Rail and Flange Lubricant is made from a highly water-resistant base and special lubricating graphite.

- A. Very stable in use and storage — will not separate in any climate along U.S. railroads . . . will not wash off rails or flanges.
- B. Pumps freely from lubricator — suitable for use in temperatures from below zero F. to over 160 degrees above.
- C. Forms and retains "button" formation on wiping bar.

Calol Rail and Flange Lubricant has a "short" non-stringy texture. This keeps it on flanges and the sides of rails and minimizes the usual tendency of grease to pull over the tops of rails.

Case 1157—Maintaining Good Air-Brake Lubrication



SECTION OF BRAKE CYLINDER AND
PISTON LUBRICATOR

Equaling or exceeding all specifications of the A.A.R., Calol Brake Cylinder Lubricant provided good lubrication in both freight and passenger brake cylinders for periods exceeding the usual three years. Recommended for the older K-type brake as well as the AB freight brake and HSC passenger brake.

- A. Resists deterioration or separation — small quantity maintains complete coverage of cylinder . . . keeps lubricator swab saturated and pliable.
- B. Minimizes swelling or deterioration of packing cup and helps to form tight seal.
- C. Provides tough lubrication film that will not ball or roll from cylinder walls.

Calol Brake Cylinder Lubricant contains more than 82% highly refined and specially selected mineral oil, and complies with A.A.R. Specifications M-914-42.

For additional information and the name of your nearest Distributor, write

**STANDARD OIL COMPANY
OF CALIFORNIA**

225 Bush Street, San Francisco 20, California

The California Oil Company
Barber, N. J., Chicago, New Orleans

The California Company
17th and Stout Streets, Denver 1, Colo.

Standard Oil Company of Texas
El Paso, Texas



Trademark Reg.
U.S. Pat. Office

This Trouble-Free PIPE WRENCH

Saves Time and Money



**RIDGID's guarantee
means no pipe wrench
housing expense — ever**

● No time out for pipe wrench housing repairs and expense with the guaranteed **RIDGID**. Sturdy construction and work-saver features make it on-the-job always, make jobs easier, too. Adjusting nut spins freely in all sizes, 6" to 60." Handy pipe scale on hookjaw. Instant action non-slip, non-lock jaws. Powerful comfort-grip I-beam handle with flared end that keeps your hand from slipping off. It's the world's most popular wrench for good reasons. . . . Buy **RIDGID** wrenches at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS

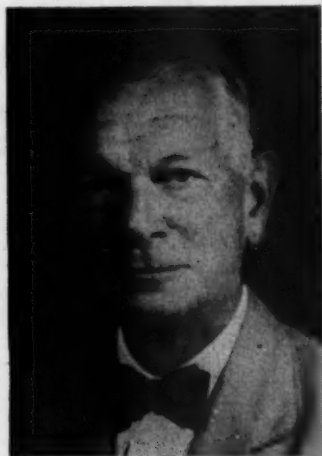
THE RIDGE TOOL CO. • ELYRIA, OHIO

which will be supplied by Gould), are to be paid by the companies sending students. As in the past, the students are given periodic tests and awarded diplomas at the end of the course.

WESTINGHOUSE ELECTRIC CORPORATION.
—John A. DeGroot, formerly of the general contract department at Pittsburgh, Pa., has been appointed assistant to the Pacific coast district manager, with headquarters at San Francisco, Calif., succeeding W. J. Howell, who has been appointed assistant to the apparatus sales manager at Pittsburgh.

AMERICAN BRAKE SHOE COMPANY.—Joseph H. Parsons and Robert B. Pogue have been appointed vice-presidents and Rosser L. Wilson has been appointed chief engineer of the Brake Shoe and Castings Division of American Brake Shoe Company.

Mr. Parsons, formerly assistant vice-president, will be in charge of miscel-



Joseph H. Parsons

laneous castings sales. He joined the company as an apprentice after graduation from Princeton University in 1913.

Mr. Pogue, formerly chief engineer, continues in charge of engineering. He has



Robert B. Pogue

been with the Brake Shoe Company since 1916 and chief engineer of the division since 1937.

Mr. Wilson, formerly assistant chief en-

Piled Up Production

FULL OF ECONOMIES

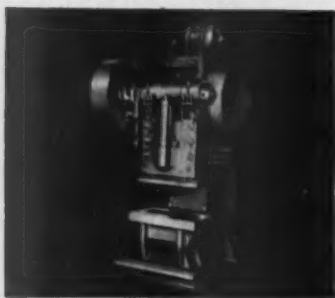
*Bullard
Cut Master
V.T.L.*

THIS 36" Bullard Cut Master V.T.L., recently installed in the Moncton, New Brunswick, shops of the Canadian National Railway is just piling up the production of locomotive parts with unusual economies on every job. Everyday production includes boring and turning rod bushings, turning, boring, slotting and counter-boring pistons, turning and boring valve bull rings, and many other parts.

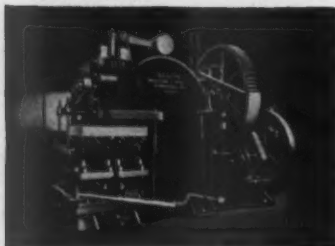
The Cut Master does accurate work and much more. It cuts time on cuts and cuts time between cuts. That's how the economies pile up. Bullard Cut Masters have tremendous power and a wide selection of speeds and feeds. It can be had in six different sizes, 30", 36", 42", 54", 64", 74", with choice of six different head combinations on the four larger sizes.

THE BULLARD COMPANY

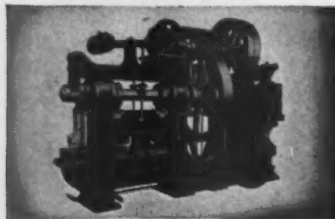
BRIDGEPORT 2,
CONNECTICUT



BEATTY Single End Punch available in capacities up to 200 ton.



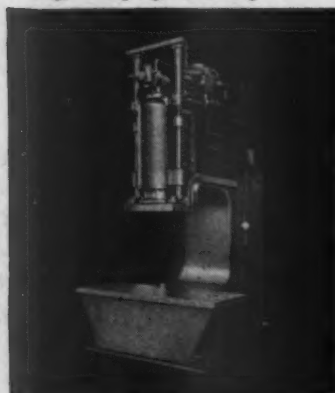
BEATTY No. 11-B Heavy Duty Punch for production tooling and use with BEATTY Spacing Table.



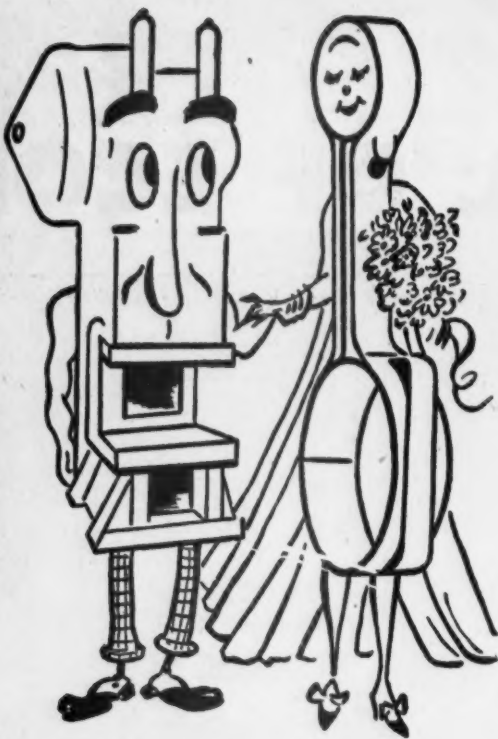
BEATTY Co-Pun-Shear — one unit does coping, punching, shearing.



BEATTY Horizontal Hydraulic Bulldozer for heavy forming, flanging, bending.



BEATTY 250-ton Gap Type Press for forming, bending, flanging, pressing.



SHOTGUN WEDDING

Fast, low-cost production today demands machines correctly designed, correctly tooled for the specific job to be done. It demands perfect mating of machine to job, and this calls for the best engineering experience available to you. Here is where BEATTY ENGINEERING comes in. We know there is a BETTER way to do most production jobs. Our broad experience in finding that better way for so many companies is assurance that we can contribute to the solution of your problems. Write or phone us about your needs. Your best insurance for fast, quality production at a competitive cost is a BEATTY machine engineered to your specific needs.



BEATTY MACHINE AND MFG. COMPANY
HAMMOND, INDIANA



Rosser L. Wilson

gineer, joined the company as an engineer in 1935. He is a graduate of Purdue University.

KAISER STEEL CORPORATION. — The Kaiser Company, Inc., has changed its name to the Kaiser Steel Corporation, with main offices at Oakland 12, Calif.

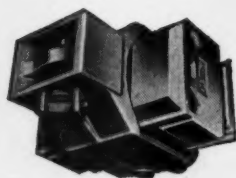
AMERICAN LUMBER & TREATING CO. — The American Lumber & Treating Co. has realigned sales responsibilities in two of its district offices. C. D. Bird, formerly middle Atlantic district manager at Washington, D. C., has been appointed district sales manager of the company's newly-organized south central sales region, with headquarters at the Exchange building, Little Rock, Ark. The Washington office has been closed. J. P. Johnson, Jr., formerly sales representative at Philadelphia, Pa., has been appointed to succeed Mr. Bird as district sales manager of the middle Atlantic region, with offices to be located at the company's plant in the Fairfield district of Baltimore, Md.

PULLMAN-STANDARD CAR MANUFACTURING COMPANY — Richard V. Chase, New England district manager, Pullman-Standard Car Manufacturing Company, at Worcester, Mass., has been elected vice-president, with headquarters at Worcester. Mr. Chase began his carbuilding career in 1924 as lumber agent for the Standard Steel Car Manufacturing Company. Two years later he joined the Keith Car & Manufacturing Co., Sagamore, Mass., as assistant vice-president and secretary. In 1929 he was appointed assistant vice-president of the Osgood-Bradley Car Company at Worcester, and in 1932, following acquisition of Osgood-Bradley by Pullman-Standard, he became superintendent of that plant. Mr. Chase was appointed manager of works in 1944 and later that year became New England district manager.

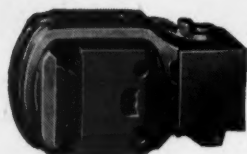
TIMKEN ROLLER BEARING COMPANY. — H. L. Hexamer, who was recently appointed district manager, Railway division of the Timken Roller Bearing Company, at St. Louis, Mo., has been transferred to Cleveland, Ohio, in a similar capacity. Paul N. Wilson, district manager, Railway division, Chicago, will temporarily

Service Proven Performance

OF NATIONAL RUBBER-CUSHIONED DRAFT GEARS FOR DIESEL ELECTRIC LOCOMOTIVES



Type M-385 for extremely heavy diesel and electric freight locomotives.



Type M-380 for heavy diesel passenger locomotives and electric freight locomotives.



Type M-350-A for diesel passenger locomotives.



Type M-375 for diesel switching locomotives.

Proved performance in both laboratory and long service, for smooth operation, utmost protection, with a proved low-maintenance cost, are NATIONAL Rubber-Cushioned Draft Gears' Certificates of Merit for diesel electric locomotives.

**NATIONAL MALLEABLE AND
STEEL CASTINGS COMPANY**

Cleveland, Ohio

NATIONAL

Products

FOR TRANSPORTATION
AND INDUSTRY



Est.

1863

Specify **JOHNSTON FURNACES**

For DEPENDABLE Results . . . FAST!

JOHNSTON furnaces for every heating job—engineered and built to your needs. Known for **SAFETY** and **DEPENDABILITY**.

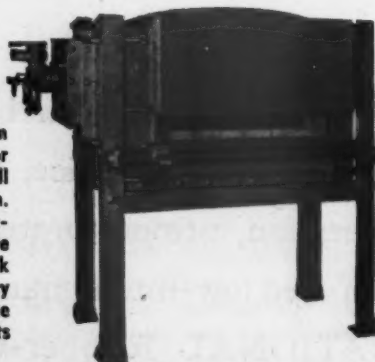
TOOL FURNACES

—designed to cover all ranges of tool heat treatment. Furnace shown is underfired, complete with Johnston Blower mounted as shown and oil burner mounted at rear. Furnace and combustion chambers, separated by special hearth tile, with openings between arranged so that flame will not pass into heating chamber or strike the stock.



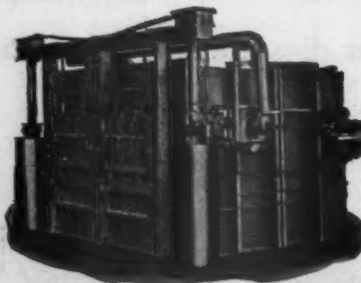
SLOT TYPE FORGING FURNACES

This furnace will maintain uniform neutral or reducing atmosphere for forging and welding which will avoid scale and decarburization. Construction features water, refractory or cast iron shields. Fire brick and insulating refractory brick lining with chrome refractory hearths are new features to reduce maintenance and operating costs and speed production.



FORGING FURNACES

Single End Door Type shown has one chamber 9" wide, 6" deep, and two doors 20" high—one 2" wide, the other 2'6" wide. Other door arrangements to suit. Fired from the ends with two burners. Complete with Johnston Electric Type Valveless Automatic Control and hydraulic door hoisting mechanisms.



The JOHNSTON line also includes Blacksmith Forges, Rivet Forges, Tire Heaters, Burners, Blowers and other equipment to **SPEED PRODUCTION—SAFELY!**



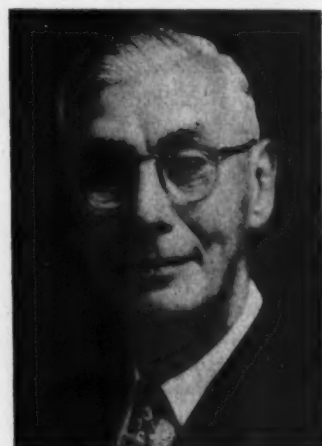
JOHNSTON

MANUFACTURING CO.
2825 EAST HENNEPIN AVE.
MINNEAPOLIS 13, MINN.

ENGINEERS & MANUFACTURERS OF INDUSTRIAL HEATING EQUIPMENT

handle railway sales at St. Louis, in addition to those at Chicago. The St. Louis office will be maintained at a new location, 2100 South Vandeventer avenue. A photograph and sketch of Mr. Hexamer's career appeared in the June issue, page 351.

SIMMONS-BOARDMAN PUBLISHING CORPORATION.—*Frederick J. Fischer*, sales representative of the Simmons-Boardman Publishing Corporation, publishers of the *Railway Mechanical Engineer* and other transportation papers, has retired after 30



Frederick J. Fischer

years' service with the company. Mr. Fischer was born in Washington, D. C., on November 27, 1889. He attended Columbia University, the Cooper Institute, New York, the Mechanics Institute, New York, and Harriman University. He began his career in the engineering and manufacturing departments of the Western Electric Company and subsequently worked for the Westinghouse Electric & Manufacturing Co. as assistant superintendent of production, at the Newark, N. J., factory, and in the construction department of the American Telephone & Telegraph Co. He was draftsman, inspector, and assistant engineer, successively, in the electrical department of the New York Central and, later, president and chief engineer of the Fairbanks Electric Company, Stamford, Conn. Mr. Fischer joined Simmons-Boardman in 1919 as a sales representative, which position he held at the time of his retirement.

LIQUID CARBONIC CORPORATION.—*W. A. Brown, Jr.*, formerly vice-president of the compressed gas division of the Liquid Carbonic Corporation, with headquarters at New York, has been appointed vice-president and general manager, with headquarters at Chicago.

INTERNATIONAL STEEL COMPANY.—*Frank E. Cheshire*, whose appointment as manager of sales, railway division, of the International Steel Company, Evansville, Ind., was reported in the August issue, was born at Cumberland, Md., on April 27, 1898. He was educated at Potomac State College, Keyser, W. Va., and Davis-Elkins College, Elkins, W. Va., and entered railroad service in 1915 as a special

Dependable Power with KOPPERS K-SPUN Piston Rings

HUSKY POWER NEEDED

.... ON THE ALCAN HIGHWAY!

THE tough grind of scheduled service on the Alcan Highway is another recent experience that demonstrates the superiority of Koppers Piston Rings. They have set new records for dependability and economy in airliners, Diesel locomotives, ocean-going tugs—every kind of service on land, sea, and in the air.

The reasons for the spectacular performance of Koppers American Hammered Piston Rings are these—K-Spun, the miracle metal for piston rings, and Porous Chrome* plating. Where dependability and economy are "musts," you'll find that engine builders and operators specify Koppers Piston Rings.

Take the first step to longer ring life and better performance—check with Koppers engineers. Koppers Company, Inc., Piston Ring Dept., Box 626, Baltimore 3, Maryland.

*VAN DER HORST PROCESS



WHAT POROUS CHROME PLATING AND K-SPUN METAL MEAN TO YOU

1. Guaranteed against ring breakage. Tensile strength double ordinary gray iron castings.
2. All rings seat immediately without scuffing and scoring.
3. Ring and cylinder wear greatly reduced.
4. Fifty percent more elasticity—retains shape and tension far longer.
5. Four times greater impact strength means long life in severe service.

KOPPERS

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KOPPERS PISTON RINGS





Men and women are always more confident—and do better work—with Inland 4-WAY Safety Plate underfoot. For 4-WAY's raised-lug pattern gives them sure footing... *always*. It is easy to install on floors, ramps, steps... and, made of steel, will last for years. INLAND STEEL CO., 38 South Dearborn Street, Chicago 3, Ill.

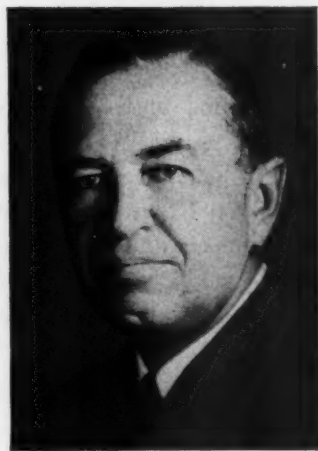
WRITE FOR BOOKLET

Inland
4-WAY SAFETY PLATE

Reg. U. S. Pat. Off.

STOCKED BY LEADING
STEEL WAREHOUSES

apprentice of the Baltimore & Ohio, at Keyser, W. Va., where he subsequently served as work inspector and assistant foreman. Later Mr. Cheshire served successively as repair accountant, shop foreman and general foreman at various points on the road. In July, 1926, he joined the Missouri Pacific as assistant general inspector, mechanical department, at St. Louis, Mo., and one year later became general inspector. In March, 1940, he was appointed assistant superintendent, car department, and in February, 1942, he was furloughed to serve with the armed forces.



Frank E. Cheshire

He subsequently held various military posts and attained the rank of colonel. Mr. Cheshire returned to the M. P. in June, 1945, and was appointed master mechanic of the Central Kansas and Colorado divisions. He became chief mechanical officer of the Chicago, Indianapolis & Louisville, at Lafayette, Ind., in 1946. He served successively with the Monon as general manager, vice-president—operation, and vice-president. Immediately prior to his association with International Steel, Mr. Cheshire was transportation engineer of the General American Transportation Corporation.

AIR REDUCTION SALES COMPANY.—F. J. Aschenbrenner, newly appointed assistant director of research and engineering of the Air Reduction Sales Company, has announced the appointment of J. K. Hamilton as manager of the apparatus research division; H. O. Klinke as assistant manager, and J. T. McKnight as superintendent of production and services section. These men are all on the staff of the Air Reduction research laboratory at Murray Hill, N.J.

AMERICAN WHEELABRATOR & EQUIPMENT CORP.—Watson P. Hall, a member of the service engineering staff of the American Wheelabrator & Equipment Corp., Mishawaka, Ind., has been transferred to the company's Toronto, Ont., sales office.

T. Max Stanger has been appointed to the sales staff with headquarters at the corporation's new sales office in Salt Lake City, Utah. Mr. Stanger, who joined American Wheelabrator nearly two years



Passenger comfort counts on RF&P's Old Dominion. That's why an Edison 88-cell A14H battery protects the 110-volt system which powers fluorescent lights, air conditioning, water coolers, kitchen appliances.



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TRENDS

in the new passenger cars...

- ✓ Higher Illumination Standards
- ✓ More Electrical Conveniences
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THEY ALL ADD UP to higher electrical loads and increased battery capacities for adequate operating reserve. That puts lightweight EDISON Nickel-Iron-Alkaline Storage Batteries in a position to save more weight per car than ever before!

The same trends also add up to a greater need for uninterrupted electric power during non-

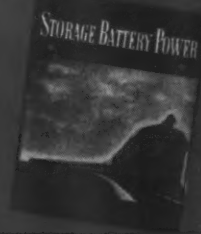
generating time on the road, thus placing greater emphasis on EDISON dependability.

If you have not purchased EDISON Batteries recently, get an up-to-date quotation from us. You'll probably find the price lower than you think, and annual cost (thanks to their well-known long life) the lowest obtainable.



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Nickel • Iron • Alkaline
STORAGE BATTERIES

Read STORAGE BATTERY POWER for information on new developments in railway cars and their power systems. Ask your EDISON district office for your free subscription.



EDISON STORAGE BATTERY DIVISION OF THOMAS A. EDISON, INCORPORATED, WEST ORANGE, NEW JERSEY

A versatile valve for general service



STEAM • HOT WATER • COLD WATER
AIR AND GAS • GASOLINE • OIL • BUTANE • PROPANE

Fig. 123 is an exceptionally rugged valve...available with various types of discs especially compounded to give top results on the services for which they are recommended. Discs can be renewed or interchanged quick as a wink, insuring long-time satisfactory valve service with negligible maintenance expense. Disc holder is slip-on type, perfectly guided. Hexagon head gland is an aid to easy repacking. A further economy feature is the distinctive long-wearing stem material developed by Lunkenheim, eliminating stem-thread failure due to wear.

The "N-M-D" valve is also regularly available in angle, check and quick operating patterns. Circular No. 558, descriptive of the complete line, is yours for the asking.

LUNKENHEIMER manufactures a wide variety of products for railroad service requirements... Valves of bronze, iron and steel; cocks, fittings, unions, air nozzles, boiler mountings and lubricating devices. Write for Circular No. 521, "LUNKENHEIMER VALVES for Railroad Service."

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THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A:

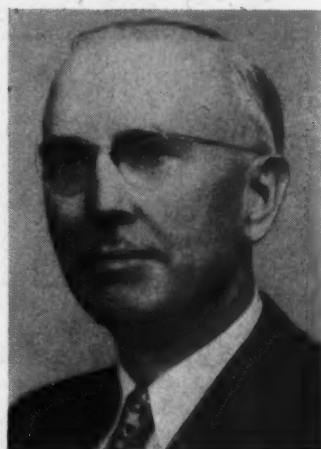
NEW YORK 13 CHICAGO 6 BOSTON 10 PHILADELPHIA 34
EXPORT DEPT. 318.322 HUDSON ST., NEW YORK 13, N. Y.

ago as a member of the service engineering staff, was formerly associated with the American Foundry & Machine Co. and with the Pacific Bell Telephone Company.

ANEMOSTAT CORPORATION OF AMERICA.—C. Milton Wilson has been appointed sales manager of the Anemostat Corporation of America. Mr. Wilson formerly was manager of sales of the Ingersoll division of the Borg Warner Corporation.

AMERICAN ARCH COMPANY—C. W. Floyd Coffin, formerly vice-chairman of the board of the American Arch Company, New York, has been elected chairman of the board of directors, succeeding S. G. Allen.

TOWNSEND COMPANY.—H. E. Chilcoat has been appointed manager of the newly created railroad sales department of the



H. E. Chilcoat

Townsend Company, New Brighton, Pa. Mr. Chilcoat was formerly vice-president in charge of sales for the Pressed Steel Car Company.

EUTECTIC WELDING ALLOYS CORPORATION.—Dr. Eugen Sovegarto has been appointed consultant and researcher on the research staff of the Eutectic Welding Alloys Corporation, 40 Worth street, New York 13. Dr. Sovegarto was born in Hungary and was educated at the University of Brunn, Czechoslovakia. He was formerly employed in metallurgical work in Germany.

PITTSBURGH STEEL FOUNDRY CORPORATION.—Thomas F. Dorsey, general manager of Fort Pitt Steel Casting division of the Pittsburgh Steel Foundry Corporation since 1945, has been elected president of the corporation.

Mr. Dorsey was elected a director in 1947, and, in December, 1948, assumed the duties of general manager of the Glassport Foundry as well as Fort Pitt.

JOY MANUFACTURING COMPANY.—The Joy Manufacturing Company, Oliver Building, Pittsburgh, Pa., has announced acquisition of all capital stock of the Mines Equipment Company. Joy will continue to manufacture the complete line of

Stainless and Mild Steel Heads

Dished and Flanged

Prices Upon Request

DISH ONLY

12 inches to 120 inches in diameter

Mild Steel $\frac{1}{8}$ inch to $\frac{5}{8}$ inch in thickness

Stainless $\frac{1}{8}$ inch to $\frac{3}{8}$ inch in thickness

FLANGE ONLY

24 inches to 144 inches in diameter

Mild Steel $\frac{1}{4}$ inch to 1 inch in thickness

Stainless $\frac{3}{16}$ inch to $\frac{3}{4}$ inch in thickness

DISH AND FLANGE

24 inches to 120 inches in diameter

Mild Steel $\frac{1}{4}$ inch to $\frac{5}{8}$ inch in thickness

Stainless $\frac{3}{16}$ inch to $\frac{3}{8}$ inch in thickness

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Heads Dished and Flared

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Cylinders Rolled and Flanged

address inquiries to

E. McCABE & CO.

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Lawrence, Mass.

Safeguard



Nothing equals Rust-Oleum—the proved rust preventive—for the lasting protection of metal—especially in closed or inaccessible areas where condensation due to temperature changes breeds rust.

RUST-OLEUM

Stops Rust!

- Rust-Oleum cuts preparation time. No sandblasting or chemical cleaners are necessary.
- Rust-Oleum outlasts ordinary materials two to ten times depending on conditions.
- Easy to use—Rust-Oleum assures lasting protection that resists rust-producing conditions.
- Apply by brush, dip or spray . . . in less time. Also available in small container sizes for economical distribution and field use.



Day and night—twenty-four hours a day—rust attacks railroad properties. Stop its deadly ravages by providing Rust-Oleum protection. Rust-Oleum coats metal with a tough, pliable moistureproof film that lasts years longer. *It's the proved answer to many rust problems.*

Rust-Oleum can be applied effectively and economically on all metal surfaces now in service—even where rust has already started. Merely wire-brush to remove scale and loose rust. Rust-Oleum merges the remaining rust into a rust-resisting, durable coating that defies time and the elements.

Save time and labor. Avoid frequent and costly replacements. Protect your properties with Rust-Oleum. Specify Rust-Oleum on new equipment, for re-building jobs . . . and for maintenance.

Get the facts now! Write for catalog containing complete information and recommended applications. Tell us your specific rust problems and we will gladly send you definite suggestions for Rust-Oleum applications.

RUST-OLEUM Corporation

2419 Oakton Street

Evanston, Illinois

Mines' products, supplementing its own stationary and portable air compressors, pneumatic drills and hoists, and "Axi-vane" fans and blowers.

BALDWIN LOCOMOTIVE WORKS.—George S. Grassmyer has been appointed manager of inspection of the Eddystone division of the Baldwin Locomotive Works. Mr. Grassmyer formerly was a member of the field service and inspection department.

ALUMINUM COMPANY OF AMERICA.—A. C. Runnetee has been appointed manager of sand and permanent-mold casting product sales for the Aluminum Company of America, succeeding Wiser Brown who is vice-president and general manager of the American Magnesium Corporation, an Aluminum Company subsidiary.

TROPIC-AIRE, INC.—Wilbur L. Brown, vice-president of Greyhound Motors has been elected president of Tropic-Aire, Inc., Chicago, succeeding Carl H. Will, deceased.

BLACK & DECKER MANUFACTURING CO.—Earl Roberts, in the service department of Black & Decker at Memphis, Tenn., has been appointed a sales engineer at Memphis.

AMERICAN HOIST & DERRICK CO.—Clarence Gush has been appointed special railroad sales representative for the American Hoist & Derrick Co., St. Paul, Minn.

AMERICAN CAR & FOUNDRY CO.—R. D. Jablonsky has been appointed district manager at the St. Charles, Mo., plant of the American Car & Foundry Co., succeeding the late W. C. Roederer.

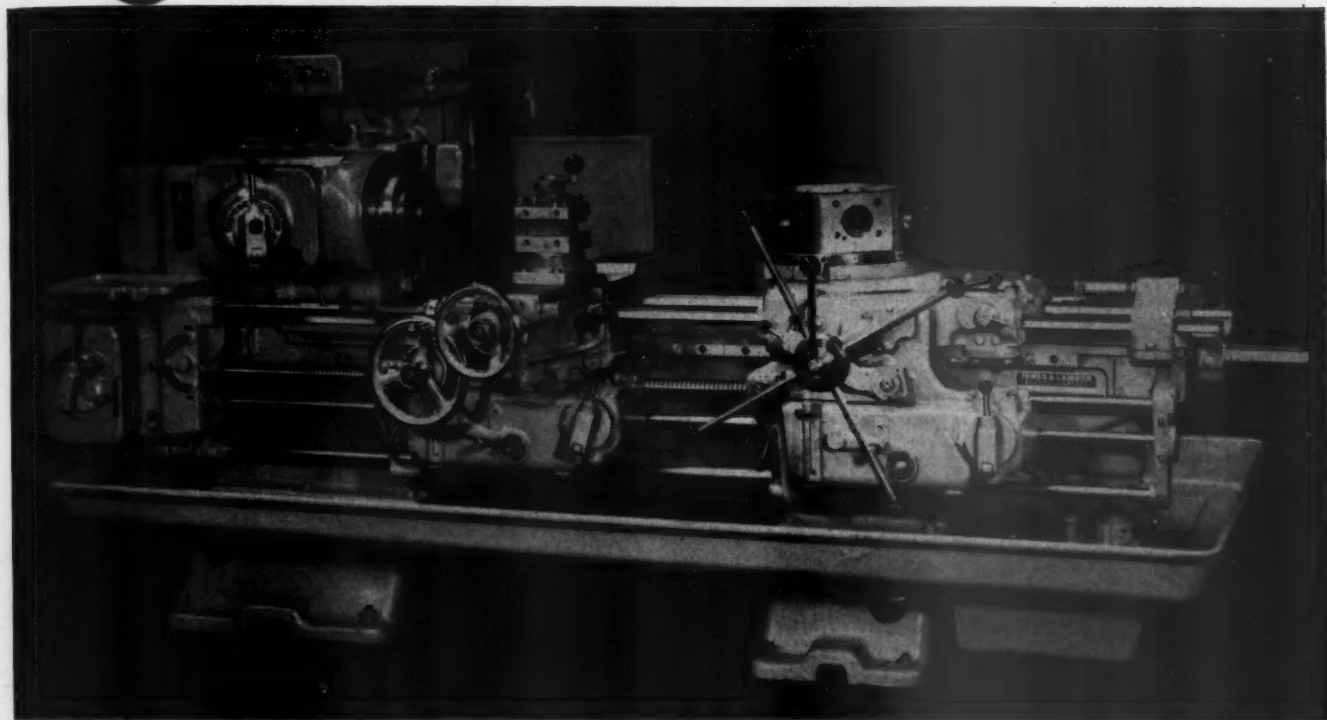
BAKER-RAULANG COMPANY—Edgar E. George, has been appointed district sales representative of the industrial truck division of the Baker-Raulang Company, with headquarters at High Point, N. C. Mr. George will serve as material handling engineer for Baker truck applications and will handle the sale of the equipment.

PRESSED STEEL CAR COMPANY—Stuart T. Hotchkiss has been appointed sales representative of the Pressed Steel Car Company at Chicago. Mr. Hotchkiss was formerly associated with Rochester Ropes, Inc., of Culpeper, Va.

AMERICAN STEEL & WIRE CO.—W. L. Corbett has been appointed to a newly created post of assistant to the district manager of the American Steel & Wire Co., Pittsburgh, Pa., a subsidiary of the United States Steel Corporation. Mr. Corbett, who will serve on special assignment, has been associated with the company since 1915. He formerly was superintendent of industrial relations at the Waukegan, Ill., plant.

Edward A. Murray, manager of the manufacturers products sales department

Over 4½ Tons of High Powered Precision!



NEW JONES & LAMSON SADDLE TYPE 7A 2½" Bar or 12" Chuck UNIVERSAL TURRET LATHE

Rugged, Functional Design, Heavy, Deep, Rigid Bed Gives New Production Efficiency

Full Length Lead Screw:

Carriage and Saddle Threading to Full Turning Length

Wide-Range, Single Lever Thread Selector

All-Sliding Gear Quick-Change Gear Box

Automatic Safety Interlocks on Threading Controls

Power Rapid Traverse for Cross Slide and Saddle—Power Indexing Turret

Lower, Wider Chip Pan with Centrifugal Coolant Pump

12 Spindle Speeds with 20 Horsepower Constant Speed Motor

All Tooling Interchangeable with Previous 7A Models

— **PLUS** all the famous Jones & Lamson characteristics of easy operation, versatility and repetitive accuracy!

**Built & Powered to Produce MORE chips per tool, MORE pieces per hour,
MORE profit per job — than any turret lathe of comparable size!**

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MACHINE COMPANY
Springfield, Vermont, U.S.A.

MACHINE TOOL CRAFTSMEN SINCE 1835

✓ Write to Dept. 710 for Complete Information

How 15 Dieselized Roads **SLASH** Cleaning Costs and Time



Save up to 18½ Man-hours with Mechanized Diesel Parts Cleaning!

YOU, too, can eliminate costly manual work, extra shifts and long soaking time in your diesel shops by mechanizing your parts cleaning.

With one Magnus Aja-Dip using Magnus 755 Decarbonizing compound, the most difficult engine parts can be cleaned in 1½ to 2 hours of agitation *without* wasting costly labor for scrubbing and scraping. Your operations are streamlined—labor requirements cut to a minimum—and engines readied for the road hours sooner.

You have the problem of higher cost labor and shorter work weeks . . . Magnus has the answer that will lower your costs and obtain greater production.

Write today for complete information on the Magnus Aja-Dip method of cleaning diesel engine parts—the method now in use in the diesel shops of 15 major railroads.

Railroad Division

MAGNUS CHEMICAL COMPANY • 77 South Ave., Garwood, N. J.

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MAGNUS CLEANERS AND CLEANING EQUIPMENT

Representatives in all principal cities

at Chicago, has been appointed manager of the Chicago district sales office, succeeding to the duties of *Clarence T. Gilchrist*, whose appointment as western area sales manager at Chicago was reported in the September issue. Appointed to succeed Mr. Murray as manager of manufacturers products sales is *Fred L. Nonnenmacher*, who has held a similar position at the New York sales office since 1948.

Obituary

WILLIAM ELLISTON FARRELL, founder and chairman of the Easton Car & Construction Co., of Easton, Pa., died at St. Luke's hospital, Bethlehem, Pa., on August 22. Mr. Farrell was 79 years old.

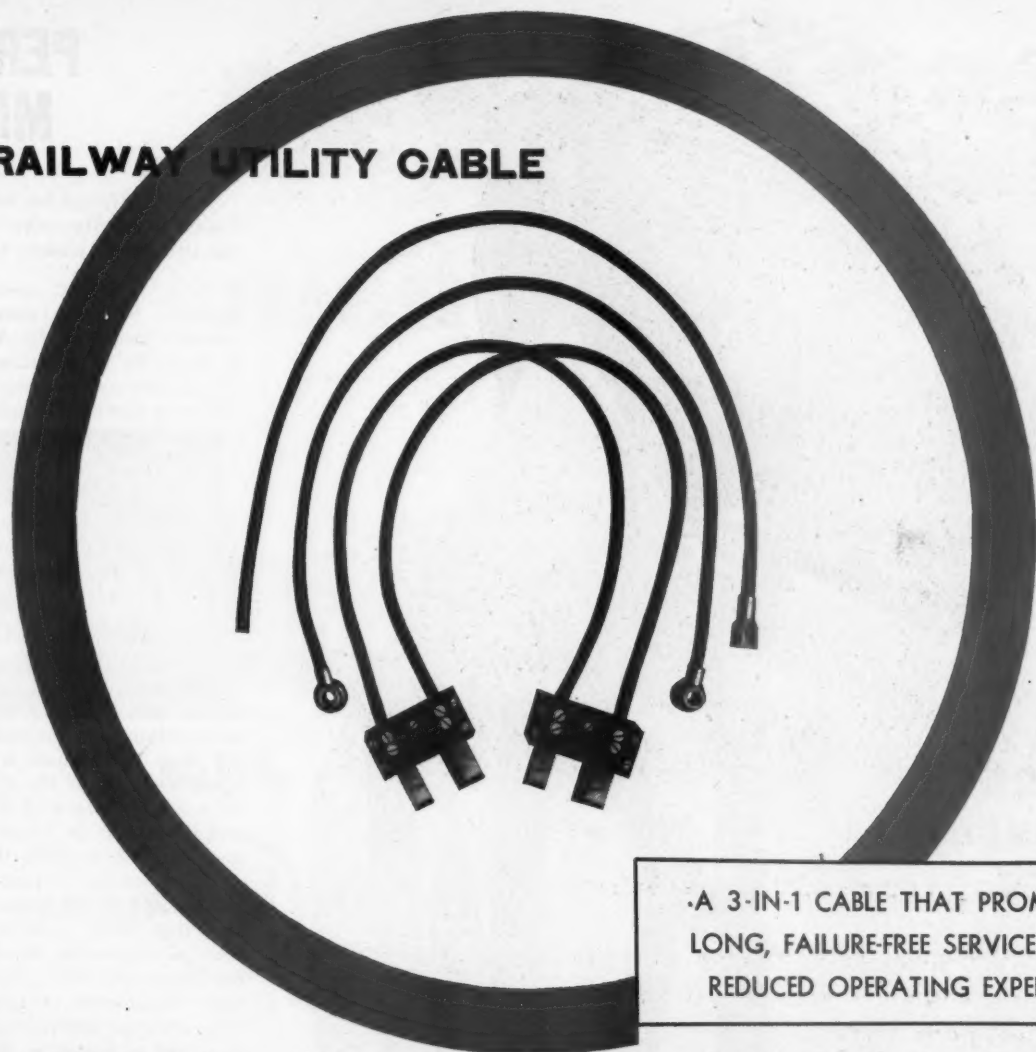
LLOYD H. DURBIN, service engineer at Butler, Pa., for the O. C. Duryea Corporation, was killed on August 11 in the crash of a private airplane near Brookville, Pa.

FRANK H. CUNNINGHAM, Pacific coast representative of the Prime Manufacturing Company, died on August 9, at his home in Santa Monica, Cal. Mr. Cunningham began his career with the Norfolk & Western and later served successively with the Standard Stoker Company, the Franklin Railway Supply Company and the Graham-White Sander Corporation.

DR. ARTHUR L. JACOBY, associate director of research for the National Aluminate Corporation, died of a heart attack on August 13, at the age of 39. Dr. Jacoby attended the Chicago public schools and received his B.S. degree in chemical engineering from the University of Illinois in 1934. He subsequently studied at Iowa State College, Ames, Iowa, where he obtained his Ph.D. degree in 1939. Dr. Jacoby entered the industrial research field in 1938, at which time he joined the National Aluminate Corporation as an organic chemist. He was assistant director of research before his promotion to associate director of research.

PHILIP M. GUBA, manager of sales, eastern area, Carnegie-Illinois Steel Corporation, a subsidiary of the United States Steel Corporation, died on August 18, in the New York Hospital, following an extended illness. Mr. Guba, who was 62 years old, attended the University of Pennsylvania and received a degree in mechanical engineering from the Spring Garden Institute. In 1909 he joined the office of the sales division of the Jones & Laughlin Steel Corp. He later was manager of sales at New York for the Donner Steel Company, which was absorbed by the Republic Steel Corporation when that company was formed in 1930. Mr. Guba joined the United States Steel organization in 1933 as assistant manager, Detroit, Mich., sales office, Carnegie-Illinois Steel, and soon after was appointed manager. In 1938 he was appointed manager, Chicago district sales, and in 1939 was appointed manager of sales, eastern area, at New York.

TIREX RAILWAY UTILITY CABLE



A 3-IN-1 CABLE THAT PROMISES
LONG, FAILURE-FREE SERVICE AND
REDUCED OPERATING EXPENSES

Simplex-TIREX Railway Utility Cable is a three-purpose cable especially designed to give top performance under the grueling conditions of railway service and to cut down operating costs.

It may be used with equal satisfaction as generator leads, train line connector cable, or as battery jumpers, thus eliminating the need for buying and stocking three different types of cable. It assures long-lasting, dependable service in each installation through the flexibility of its stranded copper conductor, the stability of its rubber insulation, and the toughness of its Selenium Neoprene jacket.

When used for generator leads, it will stand up under the constant exposure to flying gravel and the hazards of snow, sleet, and rain. As train line connector cable, it will retain its efficiency even though subjected to continual flexing and vibration. As battery jumper cable, it will withstand the twisting and the ramming between battery trays which knocks out less durable cables in short order.

For complete information on TIREX Railway Utility Cable — construction data, range of sizes, etc. — write the Simplex Railroad Department at the below address.

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SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.



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is
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**PACKAGED
MOTIVE
POWER...**
here
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the
**POWER
to KEEP
MOVING!**

Industrial trucks and tractors are not "show horses," on the stage for a brief moment... they are work horses, demanding continuous, constant, dependable power. That's why K. W. welcomes the buyer who keeps a record of battery life, maintenance cost and dependABILITY to **KEEP MOVING!**

K. W. BATTERY COMPANY, Inc.

**3705 N. LINCOLN AVE.
CHICAGO 13**

**Foot of MONTAGUE ST.
BROOKLYN 2**

PERSONAL MENTION

JOHN F. FORNER has been appointed assistant to superintendent of equipment of the Delaware & Hudson at Albany, N. Y.

A. J. HARTMAN, mechanical superintendent, Southern district and Albuquerque shops, of the Atchison, Topeka & Santa Fe at Amarillo, Tex., has had his jurisdiction extended to include the Northern district. The position of mechanical superintendent, Northern district, at La Junta, Colo., has been abolished.

T. C. SHORTT, chief mechanical officer of the New York, Chicago & St. Louis at Cleveland, Ohio, has been appointed chief mechanical officer of the Wheeling & Lake Erie.

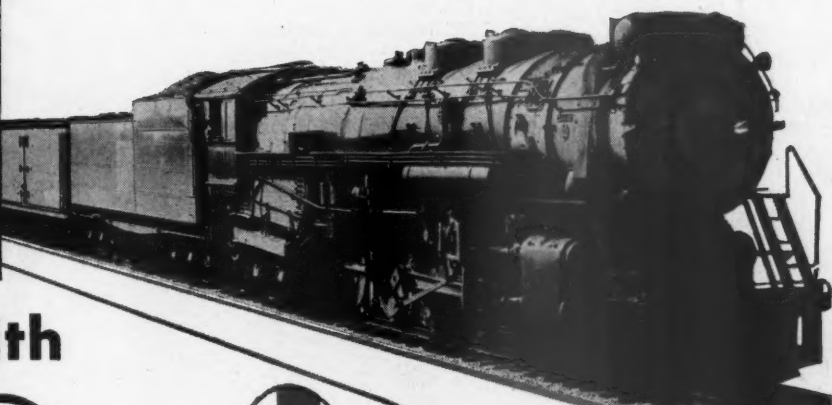
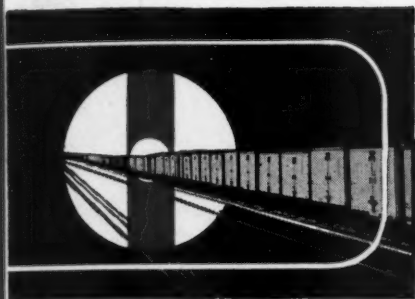
DONALD McKEOWN, whose appointment as mechanical engineer of the Boston & Maine, Maine Central and Portland Terminal, with headquarters at North Billerica, Mass., was reported in the September issue, was born on April 29, 1901, at Middleboro, Mass. He attended the public and high schools of Somerville, Mass., and Lowell Textile School (evening courses from 1934 to 1942). He entered railroad service on October 20, 1916, in the engineering department of the B&M, at Boston, Mass., transferring to the mechanical engineering department there on September 29, 1917. He was appointed stores department material inspector in 1921; assistant pattern supervisor in 1922; draftsman at Boston on May 1, 1923; office engineer at Billerica on October 1, 1927, and assistant engineer at Billerica on March 1, 1933. Mr. McKeown was appointed assistant mechanical engineer on April 16, 1941.

J. R. STEWART, assistant master mechanic of the New York Central at Niles, Mich., has been appointed general locomotive inspector at Detroit, Mich.

C. A. MOODY, who has been appointed superintendent of the Colorado & Southern in addition to his duties as superintendent of shops of the Chicago, Burlington & Quincy at Denver, Colo., as noted in the September issue, was born on January 3, 1898, at Havelock, Neb., where he entered railroad service with the Burlington in 1914. After serving as apprentice machinist in the Havelock shops he became a machinist in the engine house at Lincoln, Neb., and was later successively, gang foreman, erecting-shop foreman and general foreman at Havelock. In 1931 he was transferred to the Denver shops as general foreman and in 1939 was appointed general foreman in the manufacturing department at Aurora, Ill. He served as general foreman of the manufacturing and car departments at Aurora from 1940 to 1944, when he became acting shop superintendent at Denver, with jurisdiction over the terminal mechanical department facilities. The following July he was appointed assistant shop superin-

LEVEL OUT

HIGH-SPEED SHOCKS

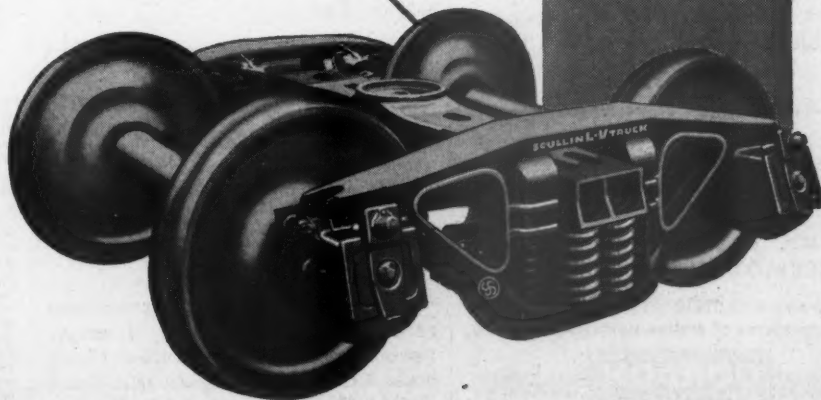


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The rougher the roadbed, the more impressive is the L-V's performance. Scullin's unique arrangement of lateral and vertical coil springs completely cushions both motions — smothers destructive bounce and sideways — makes high speed really safe-and-sound for lading, cars and track.

And on the level — L-V Trucks cost little more to install, no more to maintain than conventional trucks!

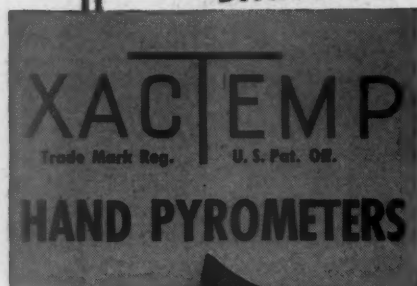


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YEARS' PROGRESS

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INSTANT, DIRECT **Temperature Readings** **Accurate to within a** **Fraction of a Scale** **Division with**



For
**All-around
 General
 Temperature
 Checking**

Specify XACTEMP PYROMETERS whenever a quick, accurate temperature determination is needed. Used for surface temperatures of welds, welded rail ends, billets, slabs, heated rollers, forgings, ovens, hot plates, furnace walls—for general inspection in furnaces,

lead and salt pots, galvanizing tanks, core ovens, type metal, etc. Long-life cast aluminum and brass construction. Medium resistance, fast-acting indicator, provided with Alnico V magnet—direct reading dial starts at 50° F. or 60° F. Simple, easy to operate—no adjustments necessary—always ready for use. Will take most types of thermocouples. A full line of thermocouples available from stock.

FOUR MODELS

Catalog No.	Range	Thermocouple
LT 800	60-800 F.	Iron-Constantan
LT 810	60-1200 F.	Iron-Constantan
LT 820	60-1600 F.	Iron-Constantan
LT 830	50-2500 F.	Chromel-Alumel

PRICE WITHOUT THERMOCOUPLE \$39.50

Ask also about XACTEMP PYROMETERS for taking temperatures of molten non-ferrous metals

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CLAUDE S. GORDON CO.

Specialists for 33 Years in the Heat Treating and Temperature Control Field

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tendent at Denver, and in April, 1946, was transferred to Sheridan, Wyo., as assistant master mechanic. Mr. Moody returned to Denver as superintendent of shops in August, 1947.

E. S. FARLEY, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been appointed superintendent of motive power, second mechanical district, with headquarters at El Reno, Okla.

HERMAN STEPHENS MERCER, whose appointment as assistant chief mechanical officer of the Seaboard Air Line, with headquarters at Norfolk, Va., was announced in the September issue, was born on November 9, 1902, at Savannah, Ga. He entered railroad service on October 25, 1919, as a machinist apprentice with the Seaboard at Savannah, Ga., becoming a machinist there on October 4, 1926. He was appointed enginehouse foreman at Savannah on March 1, 1931, and was



Herman S. Mercer

transferred to Hamlet, N. C., on March 31 of the same year. On August 16, 1937, he was appointed general foreman at Howells, Ga., and on February 1, 1940, was transferred to Raleigh, N. C. Mr. Mercer was promoted to master mechanic at Howells on May 27, 1943, and on November 24, 1947, became shop superintendent, locomotive department, at Jacksonville, Fla.

E. J. BURCK, general locomotive inspector of the Indiana Harbor Belt at Detroit, Mich., has retired after 48 years of service.

W. V. HINERMAN, assistant to superintendent motive power of the Chesapeake & Ohio at Richmond, Va., has been appointed assistant superintendent of the motive power, with headquarters at Richmond, Va.

HUCO M. MCINNES, whose appointment as assistant superintendent of motive power, Pere Marquette district, Chesapeake & Ohio, with headquarters at Grand Rapids, Mich., was reported in the September issue, was born December 22, 1897, at Toronto, Ont. He first entered railroad service in May, 1917, as head statistical clerk, auditor of disbursements, of the Pere Marquette (now part of the C. & O.) at Detroit, Mich. He joined the Detroit &



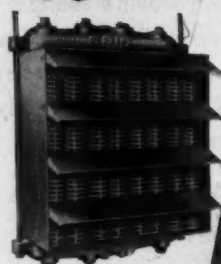
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 Gentlemen:

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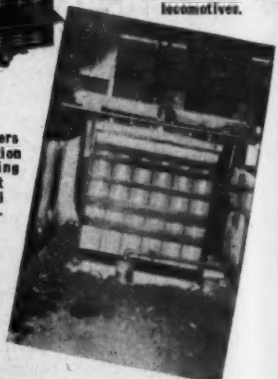
Yours very truly,
 John S. Sloan
 Supt. of Shops,



This is just one use that railroads find for GRID Unit Heaters... a plus from their heating equipment. GRID Unit Heaters are made with one piece high test cast iron heating sections—designed to save fuel cost because they provide heat where it is most needed—is the working zone. That's why GRID Unit Heaters are installed to melt ice and snow from locomotives.



GRID Unit Heaters eliminate stratification of warm air at ceiling level. GRID Unit Heaters are designed for low outlet temperatures. Whether installed for roundhouses, shops, storerooms, washrooms, offices, etc., railways all over the country report the same service. Investigate the GRID system of diesel house heating. It's new and proved for this different service. GRID condenser "An" sections have no soldered, brazed, welded or expanded connections to become loose or develop breakdowns... no electrolysis to cause corrosion, breakdowns, leaks, or heating failures, because there are no dissimilar metals used in GRID construction... GRID IS MAINTENANCE FREE.



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The low additional cost of pressure-treating car decking is an investment that pays handsome dividends in sharply reduced repair costs and longer periods of continuous, revenue-producing service.

The average length of service from untreated car decking is 3 to 7 years. Case histories in railroad

files show the average length of service from Koppers Pressure-Treated Car Decking is 12 to 15 years. Such service more than justifies our claim: *pressure-treatment is not an expense . . . it is an investment that pays dividends.*

Send for further information showing how Koppers Pressure-Treated Wood can save you time and money when used for car decking, crossings, bridges, pile foundations, pole lines, platforms and other installations.

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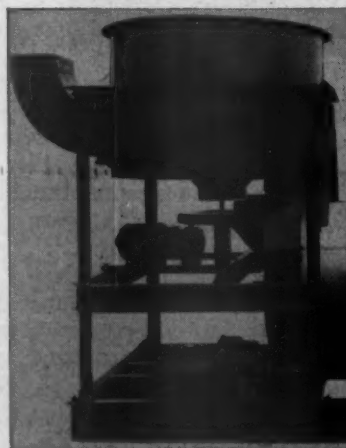
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The VILOCO Rotary Sand Dryer obtains maximum thermal efficiency. Wet sand from preheated hopper passes to revolving disc feeder thence by gravity into rotating cylinder. A curtain of sand is constantly exposed to the hot gases removing all moisture. Dry sand is screened as it passes from cylinder to outlet. Oversize material passes out of a separate discharge.

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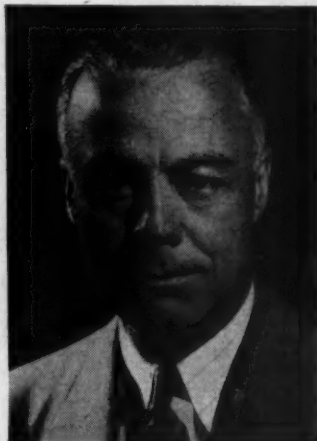
VILOCO RAILWAY EQUIPMENT CO.

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Mackinac in 1920 as chief accountant at Tawas City, Mich., and re-entered P. M. service three years later, holding the positions of accountant, chief clerk and superintendent of motive power until 1943. Mr. McInnes was subsequently appointed assistant to chief mechanical officer at Detroit.

C. J. NELSON, who has retired as superintendent, Chicago Car Interchange Bureau, as reported in the September issue, was born at Bæftoft, Denmark, on July 1, 1874. He entered railroad service in April, 1899, with the Chicago & North Western at Clinton, Iowa, serving as car repairer and inspector until his promotion to chief inspector at that point in 1902. In 1907 he was appointed assistant car foreman at Clinton, in 1910 general car foreman, and in 1915 general traveling inspector, with headquarters at Chicago. Mr. Nelson subsequently became district general foreman at Chicago. He was appointed district master car builder at Chicago in 1920, and superintendent, Chicago Car Interchange Bureau, in March, 1925.

H. W. HAYWARD, shop engineer of the Canadian Pacific at the Angus shops, Montreal, Que., has been appointed to the new position of engineer of standards and methods, with system-wide jurisdiction over standards and methods for maintenance of equipment. Mr. Hayward was born in Swindon, England, and was edu-



H. Hayward

cated in Montreal. He became a machinist apprentice at the Angus shops in 1928. A year later he became a draftsman in the mechanical department. During World War II he was on loan for two years to Associated Aircraft. For the past year and a half he has been shop engineer.

J. G. CRAWFORD, fuel engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, has retired following 48 years of service with that road. Born on July 26, 1878, and graduated by Cornell University in 1901, Mr. Crawford began his Burlington career as assistant on a dynamometer car. He later entered the road's special apprentice course at Aurora, Ill., and subsequently served in the testing laboratory, locomotive and car shops, and as assistant to master me-



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chanic. He became special inspector, motive power department, in 1905, and in the following year was made fuel engineer, to which post were added the duties of fuel inspection in 1908. In 1925 Mr. Crawford was appointed general manager and purchasing agent of the Valier Coal Company, wholly owned by the Burlington and producing coal for its use. From 1916 to 1922 Mr. Crawford was secretary-treasurer of the International Railway Fuel Association.

C. D. ALLEN, shop superintendent of the Chesapeake & Ohio at Huntington, W. Va., has been appointed assistant superintendent of motive power, with headquarters at Richmond, Va.

Diesel

W. A. LANGLANDS, superintendent of Diesel and motor-car equipment, Chicago & North Western, at Chicago, has retired.

O. P. JONES, electrical engineer of the Chicago & North Western at Chicago has been appointed assistant superintendent of Diesel and motor-car equipment with headquarters at Chicago.

W. P. MILLER, assistant superintendent of Diesel and motor-car equipment of the Chicago & North Western at Chicago, has been appointed superintendent of Diesel and motor-car equipment with headquarters at Chicago.

Electrical

C. P. TAYLOR, electrical engineer of the Norfolk & Western at Roanoke, Va., has retired.

W. S. GARRETT, general boiler maker of the Norfolk & Western at Roanoke, Va., has been appointed electrical engineer.

Master Mechanics And Road Foremen

W. L. HUEBNER, supervisor Diesel engineer, system, Atchison, Topeka & Santa Fe, at Chicago, has been appointed master mechanic of the Chicago terminal division and the Illinois division, with headquarters at Chicago.

A. A. JOHNSON, general car foreman of the Indiana Harbor Belt at Gibson, Ind., has been appointed assistant master mechanic at Gibson. The position of division general car foreman has been abolished.

L. B. CLOSE, master mechanic of the Chicago, Rock Island & Pacific at Little Rock, Ark., has been transferred to the position of master mechanic at Chicago.

R. F. CULBRETH, master mechanic of the Indiana Harbor Belt, at Gibson, Ind., has been given jurisdiction over the equipment department, including both the locomotive and car departments.

C. J. MARPLE has been appointed assistant master mechanic of the Indiana Harbor Belt at St. Thomas, Ont.

Shop and Enginehouse

HARRY P. FOSSETT has been promoted to the position of assistant machine shop foreman of the Southern at Birmingham, Ala.

M. R. FRANCIS, boiler-maker foreman of the Norfolk & Western at Williamson, W. Va., has been appointed general boiler maker at Roanoke, Va.

MORRIS K. BRIDEWELL has been promoted to the position of assistant foreman enginehouse (night) of the Southern at Birmingham, Ala.

LUTHER D. HARRISON, Sr., has been promoted to the position of assistant foreman enginehouse (day) of the Southern at Birmingham, Ala.

PAUL W. CONNALLY has been promoted to the position of assistant foreman enginehouse (day) of the Southern at Birmingham, Ala.

JAMES A. COFFMAN has been promoted to the position of foreman pipe and tin shop of the Southern at Chattanooga, Tenn.

Obituary

WILLIAM D. HARTLEY, mechanical superintendent of the Atchison, Topeka & Santa Fe, with headquarters at La Junta, Colo., died on August 10 at Las Vegas, N. M., following a heart attack. Mr. Hartley was born at Albuquerque, N. M., on August 14, 1886, and attended the New Mexico State Normal School at Las Vegas for two years. He entered Santa Fe service in April, 1903, as a machinist helper at Albuquerque and the next year became a machinist apprentice. From 1908 to 1914 he served successively as machinist at Albuquerque and enginehouse foreman at Richmond, Calif., subsequently becoming division foreman at Barstow, Calif. He returned to Richmond in 1918 as general foreman and was appointed master mechanic in 1920 at Clovis, N. M. He was transferred to Raton, N. M., the following year; became mechanical superintendent at La Junta in 1930, and was transferred to Fort Madison, Iowa, in February, 1943. Mr. Hartley was appointed mechanical superintendent at Topeka, Kan., in July, 1943, and was subsequently transferred to La Junta.

H. C. McCULLOUGH, superintendent of motive power, second mechanical district of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., died on August 5. Mr. McCullough was born at Dennison, Ohio. He began his railroad career with the Rock Island in July, 1912, at Silvis, Ill., as a locomotive fireman, and rose to master mechanic of the Cedar Rapids division in 1938. In February, 1940, he was transferred to the Rock Island division, and three years later became superintendent of motive power, second mechanical district, with headquarters at Kansas City, Mo. Mr. McCullough's headquarters were moved to El Reno in July of this year.

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